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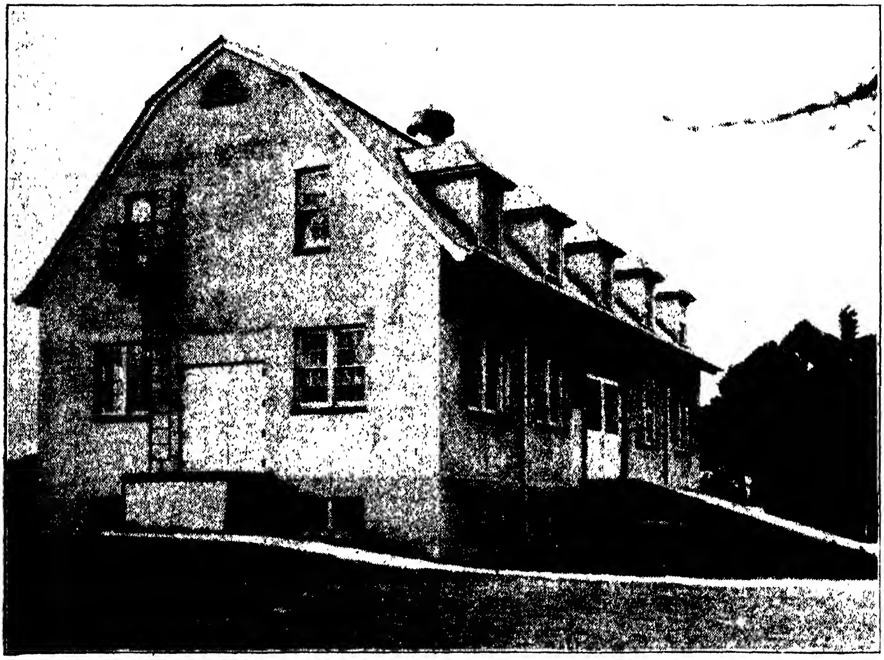


Crop service building of the agronomy department

WOODLAND PASTURE*

F. A. WELTON AND V. H. MORRIS

Among stockmen the idea prevails that the quality of woodland pasture is inferior to that of pasture grown in the open. The idea is based largely on observation. Animals of various kinds having access to both woodland and open pastures are frequently seen to graze closely that growing in the field and to eat only sparingly or perhaps not at all of that growing in the woods.

Of course, there are many things which enter into palatability. Aside from the taste and habits of the animals themselves, there are such things as the aroma and composition of the feed. The constituents that would be most likely to influence the palatability are the various sugars which, together with starch and other similar compounds, are known collectively as carbohydrates. That there should be a material difference in the kind and quantity of these compounds produced in grass grown in woodland and that grown in the open is quite conceivable because the formation of these compounds depends on the action of chlorophyll in the presence of light. With a marked reduction in intensity of light, such as would be caused by the shade of the trees, undoubtedly there would be a corresponding reduction in the quantity of the various carbohydrates formed. Of the various constituents contained in the carbohydrate compounds, palatability would be most likely to be affected by the more simple ones, such as glucose, fructose, sucrose, and starch. Accordingly, it was the purpose of this work to estimate the quantity of these various constituents in grass grown in the open and in woodland and thus to determine if there is any basis from the standpoint of composition on which to account for a difference in palatability.

In an old permanent pasture field, part of which was wooded, two areas each containing three square rods were fenced off in the spring of 1924. One location was selected beside a ravine in the open field and the other in the woods (Fig. 1). The woodland was somewhat open as a result of logging done some twenty years ago. The open spaces have been partially closed by an undergrowth of dogwood. Very few trees are over 14 inches in diameter. In the woodland area the ground was completely covered with grass but

*This work was undertaken at the instance of Edmund Secrest, state forester of Ohio, and to him the writers are indebted for helpful suggestions.

the stand was rather thin. It was partly shaded all the time but not completely shaded any of the time. The intensity of light in the woods, as measured on four different dates by Ridgeway's chemical photometer, ranged from 10 to 24 percent of that in the open. The grass was clipped with a lawn mower. Only four clippings were made during the summer, the latter part of the season being so dry that there was very little growth. Enough to make samples for analyses, however, was obtained on two later dates, thus making altogether six samples during the season.

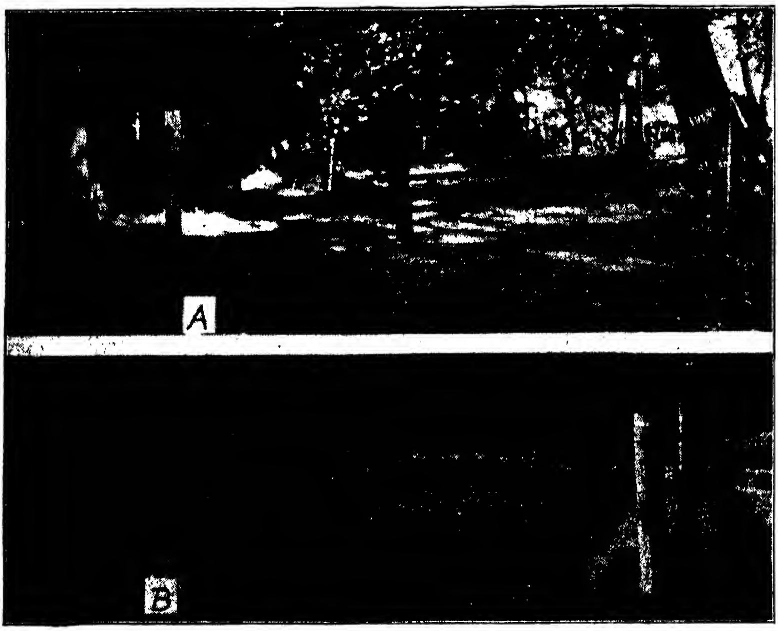


Fig. 1.—A—Open field pasture, B—Woodland pasture

The experiment was repeated in 1925, in the same pasture field but on different and somewhat more productive areas. The one in the open had been manured a few years previously. The contour of the one in the woods was such that it tended to receive drainage from adjoining territory and this, of course, favored a more luxuriant growth of grass. The shading was similar to that in the area mowed in 1924. Four clippings for yield were made, the last being on August 19. There was little growth during the balance of the season on account of dry weather. Samples for analysis, however, were obtained on one later date, thus making five altogether.

In both seasons the samples for analysis were cut into pieces ½ to 1 inch in length and then placed in wide-mouthed, glass-stoppered bottles and heated in alcohol at 172° F. (78° C.) for approximately an hour. The strength of the alcohol including the moisture contained in the grass was approximately 70 percent. After standing about three months the samples were analyzed for the simpler carbohydrate compounds.

The yields of the green and dry material calculated to an acre basis, also the relative water content of the grass grown in the open and in the woods, were found to be as shown in Table 1.

TABLE 1.—Yields of Green and Dry Grass in Open and in Woods Pasture

	1924		1925	
	Open	Woods	Open	Woods
Green weight, lb.	3,872	446	11,076	4,236
Dry weight, lb.	1,126	347	3,264	1,138
Percent of moisture	70.95	75.10	69.31	73.37

From this table it may be noted that the yield of the grass grown in the woods, on the dry weight basis, was in both years about one-third that grown in the open. The water content of the grass grown in the woods averaged about 4 percent higher than that of the grass grown in the open. Early in the season the difference in moisture content was least marked.

The percentage of carbohydrates, average of all clippings, in fresh material of the two kinds of grass were as shown in Table 2.

TABLE 2.—Percentage of Carbohydrates in Open and in Woods Pasture

	1924		1925	
	Open	Woods	Open	Woods
Glucose and fructose	0.93	0.63	0.83	0.75
Sucrose	2.70	1.38	2.22	1.47
Easily hydrolyzable carbohydrates (starch)	6.74	4.41	5.26	4.71
Total available carbohydrates	10.37	6.42	8.31	6.93

In both years and on all dates of clipping, with one exception, the quantity of the various sugars and starch was higher in the grass grown in the open than in that grown in the woodland. The single exception was in the glucose and fructose on the first date of clipping in 1925. The total carbohydrates in the open were 161 percent of the total carbohydrates in an equal quantity of grass produced in the woodland in 1924 and 120 percent of that produced in the woodland in 1925.

In each year there was more than two and one-half times as much green weight produced in the open as in the woodland. The total carbohydrates found in the open, therefore, as compared to the carbohydrates in the woodland, were at least two and one-half times 161 percent or more than 400 percent in 1924 and about two and one-half times 120 percent, or approximately 300 percent, in 1925. If an allowance were made for weeds, the difference in carbohydrates would be even greater, for in the woodland the weeds were usually more abundant. In 1924, there were 32 percent more weeds in the woodland than in the open.

That these differences in carbohydrates were due to the shading effect of the trees is confirmed by the results obtained in a supplementary test in which grass was shaded artificially in 1924 and 1925.

In these tests the shade was furnished in one case by frames made of lath and in another by frames covered with cheesecloth (Fig. 2). In each case the reduction in intensity of light was about one-half. At each time of cutting, samples of grass were taken and preserved in alcohol in the same manner as were those taken from the woodland and open pasture.

The percentage of carbohydrates, average of all clippings, in fresh material of grass grown in the open alongside that shaded artificially was as shown in Table 3.

TABLE 3.—Percentage of Carbohydrates in Grass Grown in Open and in Shade

	1924			1925		
	Open	Lath	Cheesecloth	Open	Lath	Cheesecloth
Glucose and fructose	0.96	0.62	0.60	0.69	0.44	0.48
Sucrose	2.85	1.33	1.52	2.25	1.16	1.39
Easily hydrolyzable carbohydrates (starch)	4.34	2.89	2.54	5.12	3.64	3.76
Total available carbohydrates	8.15	4.84	4.66	8.06	5.24	5.63

These results indicate that in equal quantities of unshaded and shaded grass the total quantity of carbohydrates produced in the open in 1924 was 168 percent of that grown under lath and 175 percent of that grown under cheesecloth. In 1925 it was 154 percent of that grown under lath and 143 percent of that grown under cheesecloth.

The yields of the unshaded and artificially shaded grass, however, were more nearly equal than were those produced in the open and woodland. This is perhaps to be expected for the moisture

conserved by the artificial shade would be utilized in the production of grass and not diverted to the use of the trees as in the woodland pasture. Determinations made on the soil at irregular intervals during the progress of the experiment showed that the artificially shaded plots ran from 3 to 8 percent higher in moisture content than did the unshaded plots. The average moisture content of the grass shaded by either lath or cheesecloth was about 5 percent higher than was that of the unshaded grass.

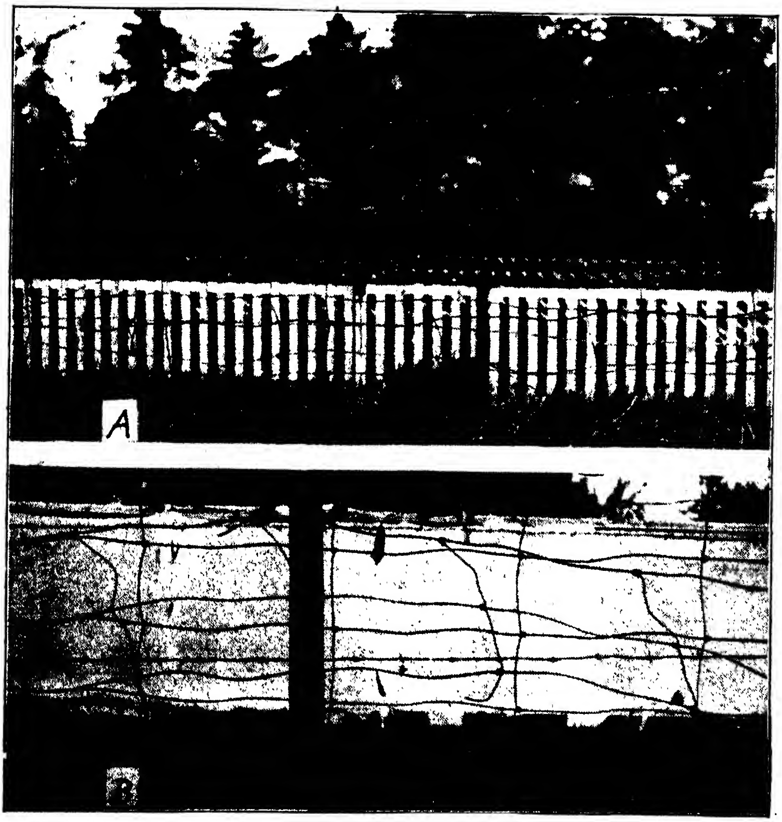


Fig. 2.—A—Pasture artificially shaded with lath, B—Pasture artificially shaded with cheesecloth

In protein content on the green weight basis the grass grown in the open was somewhat richer than that of the grass grown in the shade; but on the basis of dry weight the reverse was true.

From the material presented in this paper it is clear that woodland pasture differs from pasture grown in the open in both quantity and quality. The nature of the difference in quality, that

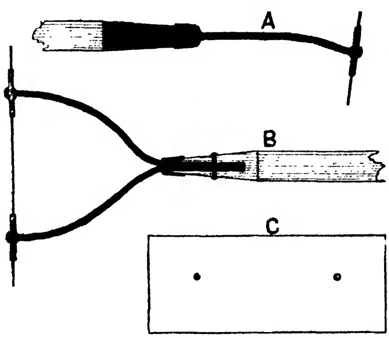
is, the reduction in sugars and other simple carbohydrate compounds in the woodland pasture would certainly make it less nutritious and quite probably less palatable, for animals of most kinds have a relish for sweet things. Foresters have long advocated the advisability of excluding livestock from timber land, particularly of hardwoods, on account of injury sustained thru defoliation, cropping of bark and stems, uprooting and killing seedlings, trampling roots, packing the ground, etc. Farmers contend that these injuries are more than offset by the pasture obtained. In view of the relatively small quantity and inferior quality of the woodland pasture it would seem that this claim is not well founded.

SCRAPER FOR CLEANING DROPPINGS BOARDS

D. C. KENNARD

If there is one utensil that practically every poultry keeper needs but does not have, it is a good scraper for cleaning the droppings boards. Some manufacturers are making scrapers for this purpose but they are seldom carried in stock at the local hardware store. Until a really satisfactory scraper is made and stocked by local merchants, poultry keepers will be obliged to have them made to order. This can be easily done by following these suggestions:

First, secure a hoe or rake handle of the desired length and size, fitted with an iron ferrule. The scraper blade may be made of an old saw, or steel plates desirable for the purpose can be purchased at small cost.* The steel plate should be 4 by 10 inches and made of 1/16-inch steel. By taking the handle and steel plate to a blacksmith or machine shop the scraper can be completed by following the sketch and the details given below.



A. Side view of scraper. Note how the lower edge is turned in one-half inch to make it cling to the boards. For scraping next to wall turn scraper over and use top edge.

B. Top view of scraper showing attachment to rake or hoe handle. The handle is 4 to 5 feet long and should be strong, rather stiff, but not too heavy. The handle should have a strong iron ferrule to receive forked irons connecting handle to scraper. These irons may be made of 5/16 or 3/8 square or round steel to make it strong and stiff. The ends which go into handle may be tapered or reduced in size somewhat and welded. Make sure it is riveted thru the ferrule.

C. Blade for scraper 4 by 10 inches. The 3/16 or 1/4 inch holes are two inches from ends and the edge of holes is 1/4 inch above the middle.

FIG. 1.—SCRAPER FOR CLEANING DROPPINGS BOARDS

*If it is desired to purchase the steel plates address a postal to the Ohio Experiment Station, Wooster for manufacturer's address.

FORMALDEHYDE DUST FOR THE CONTROL OF OAT SMUT

J. D. SAYRE

A report on a new dust treatment for the control of oat smut was published in the Bimonthly Bulletin, Jan.-Feb., 1928. The results showed that almost perfect control of oat smut could be obtained with various strengths of formaldehyde dusts. In 1928 similar combinations were repeated in experimental plots, and the dusts were tried also in a wide commercial way. Aside from the home-made mixtures, Smuttox, a commercial product in which formaldehyde is incorporated into a dust, was used.

PLOT TESTS

In these tests 1/100-acre plots and rod-row plots were used. The plots were arranged in triplicate, the checks being placed in the usual sequence. Several methods of treatment of grain were used with three strengths of dust. In one, the grain was treated with the dust in a 5-gallon keg, the treated grain remaining over night in sacks. Another set was sown immediately after treating. The third batch of grain was treated on the floor, sacked and allowed to stand over night. The results of the test are given in Table 1.

TABLE 1.—Field Plots of Oats, Sown April 20, 1928

Treatment	Percent smut
4 percent formaldehyde dust	0.18
6 percent formaldehyde dust	.10
8 percent formaldehyde dust	.05
6 percent formaldehyde dust, kaolin filler	.08
Smuttox,* keg treatment	.11
Smuttox,* floor treatment	.20
Smuttox,* treated just as sown	2.50
Checks, average of 39	13.10

*Commercial name of 4-percent formaldehyde dust.

The control of oat smut was again nearly perfect. The results indicate that the closed-container method of treatment is slightly better than the floor-shoveling method. They also show that it is very important to allow the grain to stand over night in sacks before sowing.

Careful observation showed that the treatment with either a 4 or 6 percent dust, or Smuttox, gave no injury to germination. To

test this point further, several samples of grain were treated with 4, 6, and 8 percent formaldehyde dust and sacked. Germination tests were made of these at 2-day, 4-day, and weekly intervals. The 4 and 6 percent dusts showed no injury at the end of 30 days, at which time no odor of formaldehyde remained. The 8 percent dust gave slight injury.

COMMERCIAL FIELD TESTS

The results of 1927 and 1928 were obtained from small plots. The treatments were made in small lots of grain and it might be assumed that the dusts had a more favorable chance than they would have had in the hands of the grower. To determine this point a large number of field tests distributed widely thruout the State were conducted by Professor Pierstorff, of the Extension Division of Ohio State University. Smuttox was sent to the growers and applied by them. The results of these tests are given in Table 2.

TABLE 2.—Results of Smuttox Demonstrations, 1928

County	Percentage of smut in		
	Check, no treatment	Smuttox treated	Formaldehyde wet treated
Ashtabula	(No check)	0.7	....
Ashtabula	6.3	.4	2.0
Auglaize	6.0	0	1.2
Auglaize	5.4	Trace	.6
Auglaize	1.4	Trace	Trace
Auglaize	Trace	0	0
Carroll	14.6	0	Trace
Clark	5.0	.3	....
Columbiana	Severe last year	1.0	1.0
Coshocton	0	0	0
Crawford	6.0	0	....
Crawford	6.1	0	....
Crawford	3.0	0	....
Crawford	6.6	.0	2.4
Cuyahoga	8.5	.1	.1
Mercer	13.0	Trace	....
Mercer	15.0	0	....
Wayne	19.0	0	....
Wayne	26.5	0	....
Wayne	20.0	0	....
Wayne	0	Trace	....
Wood	7.4	.5	2.9

In practically every case the field demonstration resulted in perfect control of smut.

THE METHOD OF DUSTS

The method of applying the formaldehyde dust or Smuttox need not be confined to any one procedure. However, in trying out several methods the following proved to be effective, simple, and

quickest. A salt or sugar barrel makes a good light container. Nail two or three cleats inside to act as baffles for thoro mixing. Select a piece of oil cloth or tightly woven cloth large enough to fit over the end of the barrel and a rope or strap to fasten it on. Place 6 ounces of the dust with 2 bushels of grain in the barrel, cover the barrel, and roll from 6 to 10 feet on the floor. The treated grain is then sacked and allowed to stand over night; it is then ready for sowing. No harm will result if the grain stands longer, or indefinitely, and if all is not sown, the surplus can be used as feed. **The only precautions necessary are (a) about 3 ounces of dust must be used per bushel of grain; (b) this must be thoroly mixed with the grain; and (c) the grain must be allowed to stand at least over night in sacks.**

Another method that can be used is as follows: Spread 10 to 15 bushels of grain on the barn floor. Add 3 ounces of the dust for each bushel of grain and shovel over two or three times, and sack. The method seems simpler and easier than the first, but it is not. By repeated tests we have found that two men can treat a bushel a minute by the barrel method while it takes twice as long by the shoveling method.

A churn or cement mixer may also be used but either is more time consuming. Another feature of the dust is that it is easy to handle. If a measuring cup or balance is not at hand a handful of dust, that is, what one can grab in one hand, is approximately 3 ounces will do no harm, and it will not be particularly harmful to the hand.

COST OF TREATMENT

The cost of treatment is approximately 15 cents per acre. Smut usually reduces the yield 6 or 10 bushels per acre. Aside from this the removal of the smut eliminates the black dust nuisance in handling and threshing the grain.

NO EXCUSE LEFT FOR HAVING SMUT IN OATS

1. The cost is negligible.

2. The treatment is simple, not disagreeable, and requires but very little time.

3. The chances for injury to the seed is practically nil.

PREPARING GRAIN MIXTURES OF SPECIFIED PROTEIN CONTENT

A. E. PERKINS

The many mixed dairy feeds offered on the market have come to be classified and designated largely by their content of total crude protein. This system of describing feeds has been widely adopted, altho it fails in several important details to render a full and accurate statement of their value.

The digestibility, which varies to a marked extent between the different feeds, is not taken into account. All of the feeding standards and most of the popular instructions for preparing balanced rations are based on digestible protein rather than on total protein. Confusion has often resulted among those not thoroly familiar with the terms.

There seems to be a widespread desire to know just where the home-grown feeds fit into this classification and to what extent and in what proportion they may be used in making up the mixtures containing varying percentages of total crude protein. The demand for such information has been intensified by the rapid development of grinding and feed-mixing equipment.

This article was prepared to suggest the maximum possible use of home-grown feeds in preparing grain mixtures containing stated amounts of total crude protein. The proper use of such mixtures in the dairy ration is also considered. The use of home-grown grains wherever possible is usually of decided economic advantage.

Formulas for grain mixtures having a wide range of protein content are given in the accompanying tables. The percent of protein which it is advisable to supply in the grain will depend on the kind and quality of the roughage used and the relative prices of corn and oats as compared with the high protein grains. Authorities are not fully agreed on this point. The writer believes it entirely practical to use a ration lower in protein than is prescribed by many, especially when corn and oats are relatively abundant and cheap, as is the case this season.

For use with good alfalfa, soybean, or clover hay, with or without silage, a mixture of about 14 percent protein content is suggested. This will call for 10 to 12 percent of high protein grain in the mixture. For use with non-leguminous roughage, such as

timothy hay or corn stover, an 18 to 20 percent protein mixture is suggested. This will usually require 30 to 35 percent of high protein grains. For use with mixed hay an intermediate grain mixture is suggested.

Instead of the exact weights stated in the tables a multiple of 10 or 25 pounds may be taken if more convenient. Comparison with the tables on either side will readily show the approximate protein content of the resulting mixture. .

The tables are based on average analyses of the feeds. Feeds analyzing below the average in protein are frequently encountered. It would thus be necessary for anyone offering the feeds for sale on a minimum protein guarantee to increase by about 5 percent the amounts of the high-protein materials as specified in these tables.

The number of good combinations of common feeding stuffs which could be made is practically limitless and no claim is made that the mixtures here suggested offer the only desirable combinations from every point of view. Corn and oats are selected as the two grains most commonly grown in this state for livestock feeding and are prescribed in equal amounts. This proportion can be changed in either direction. Other grains, such as wheat, barley, rye, or buckwheat, can usually be substituted for part of either the corn or oats, on the basis of equal weights, without great change in either the protein content or total feeding value of the mixture.

TABLE 1.—Grain Mixtures of Specified Total Crude Protein Content Using Maximum Amounts of Corn and Oats

Protein, percent	14	16	18	20	22	24
Corn, ground shelled	420	365	325	275	225	200
Oats, ground	420	365	325	275	225	200
Bran	50	100	100	125	150	125
Linseed oilmeal	55	85	125	162	200	237
Cottonseed meal	55	85	125	163	200	238

In specifying linseed oilmeal and cottonseed meal as the representatives of the high protein group of feeds it has not been our purpose to discourage the use of other high-protein feeds. These two, however, are the most generally available and the best known and therefore have been used as the representatives of their class. Peanut oilmeal, 40 percent corn gluten meal, ground soybeans, or soybean oilmeal may be substituted for equal weights of either of the high-protein grains as specified in the tables whenever considerations of price or availability make such a change desirable, without greatly affecting the protein content of the

mixture. It is always advisable to use a variety of grains rather than a single grain, for example, corn and oats rather than either alone. This principle is especially applicable to the use of high-protein supplements. Cottonseed meal from the sole standpoint of supplying digestible protein most cheaply may often seem a much better buy than linseed oilmeal. From the standpoint of keeping the animals in good condition, however, linseed oilmeal should be included in most grain mixtures, especially if no silage is fed and the roughage does not consist mostly of legume hay.

TABLE 2.—Grain Mixtures of Specified Total Crude Protein Content Using 10 Percent Molasses and Maximum Amounts of Corn and Oats

Protein, percent ☞	14	16	18	20	22	24
Molasses	100	100	100	100	100	100
Corn, ground shelled	330	300	250	225	200	175
Oats, ground	330	300	250	225	200	175
Bran	100	100	120	100	90	50
Linseed oilmeal	70	100	140	175	200	250
Cottonseed meal	70	100	140	175	210	250

Wheat bran is included as an ingredient in most of the mixtures because it is a good conditioner and adds both bulk and palatability to the ration. It is also the best single source of the mineral phosphorus. However, if its price seems prohibitive, it may be omitted. Bran is of intermediate protein content, about 16 percent. Most of the mixtures recommended for feeding vary but little in either direction from that value. It follows that the amount of bran used can be varied within much wider limits than any of the other feeds discussed, without marked effect on the protein content of the mixture. Table 3 shows a series of mixtures made without the use of bran.

TABLE 3.—Grain Mixtures of Specified Protein Content Using Maximum Amounts of Corn-and-cob Meal and Oats, Without Bran

Protein, percent ☞	14	16	18	20	22	24
Corn-and-cob meal	430	390	355	320	280	245
Oats	430	390	355	320	280	245
Linseed oilmeal	70	110	145	180	220	255
Cottonseed meal	70	110	145	180	220	255

Tables 1, 2, and 5 suggest the use of ground shelled corn; while Tables 3 and 4 are based on the use of corn-and-cob meal, resulting from the grinding of kernels and cob together. Corn shipped for any considerable distance is nearly always shelled, the inferiority of the cob being generally recognized under such conditions. In the case of corn fed near the point of production the

question frequently arises as to whether it is not better to grind the cob also, making corn-and-cob meal instead of meal from the kernels only. This method saves the operation of shelling but a more efficient and more expensive mill and more power are required when the cob is ground. The cob constitutes approximately one-fifth by weight of ear corn and is mostly indigestible woody material. Cob is of quite similar composition to the coarsest part of corn stover which the animal ordinarily refuses to eat.

TABLE 4.—Grain Mixtures of Specified Protein Content Using Maximum Amounts of Corn-and-cob Meal and Oats, 10 Percent Bran and Approximately Equal Amounts of Cottonseed and Linseed Oilmeals

Protein, percent ☞	14	16	18	20	22	24
Ground corn-and-cob meal	395	355	320	285	245	210
Ground oats	395	355	320	285	250	210
Bran	100	100	100	100	100	100
Linseed oilmeal	55	95	130	165	200	240
Cottonseed meal	55	95	130	165	205	220

When at least one-fourth of the grain mixture is light, bulky feeds, such as ground oats or wheat bran, the corn-and-cob meal is of no more value than the ground kernels it contains. Ground corn alone or supplemented by the various oilmeals is too heavy and compact or too sticky for the most efficient mastication and digestion. In the absence of other bulky feeds, ground cob as found in corn-and-cob meal improves the physical condition of such a grain mixture and thus becomes of considerable benefit. The presence of cob may be objectionable in liberal feeding to encourage the highest possible production on account of reducing the cow's appetite. The advantage of either method over the other is not great, so that the relative expense and convenience may be the deciding factor.

In purchasing corn-and-cob meal it is well to keep in mind the ease with which this commodity can be adulterated by the introduction of surplus cob. It is doubtful if the price of corn-and-cob meal should ever be more than 80 percent the price of meal from shelled corn. Tables 3 and 4 show the use of corn-and-cob meal in the preparation of mixtures of specified crude protein content.

In addition to the grains mentioned, whose use in the concentrate ration may be regarded as standard, other materials are often employed.

GROUND ALFALFA IN THE CONCENTRATE RATION

Since alfalfa is so well relished by dairy cows and possesses a protein content approaching that of wheat bran and is also bulky it has frequently been suggested to take the place of bran in concentrate mixtures. It is a much better absorbent of liquids than most concentrates, which adds to its popularity as an ingredient of proprietary feeds that contain molasses.

Alfalfa, like other roughages, has a high content of crude fiber and is lower in total nutrients than the concentrates. In the use of ground alfalfa in mixed feeds there is considerable opportunity for fraud and the purchaser needs to be well on his guard. Alfalfa-leaf meal is widely used as an ingredient of mixed feeds for poultry and swine and commands a higher price than straight alfalfa meal. It is obtained by screening the finer portions from partly ground alfalfa. In many cases the coarser residue of alfalfa stems finds its way into dairy feeds as ground alfalfa, altho, of course, it is much less valuable.

TABLE 5.—Grain Mixtures Containing 10 Percent Each of Ground Alfalfa, Bran, and Molasses, and Maximum Amounts of Corn and Oats

Protein, percent ☞	14	16	18	20	22	24
Alfalfa	100	100	100	100	100	100
Molasses	100	100	100	100	100	100
Bran	100	100	100	100	100	100
Corn	295	260	220	185	145	105
Oats	300	260	225	185	145	105
Cottonseed meal	55	90	130	165	205	245
Linseed oilmeal	50	90	125	165	205	245

Good alfalfa is recognized as the best known roughage for dairy cows, but its price per ton as a roughage even in times of scarcity will rarely equal the price of the cheapest concentrate and will ordinarily average only slightly more than half the price of the concentrate mixture. Experiments at this and other experiment stations have shown that the grinding of alfalfa hay or similar roughage does not increase to any appreciable extent its productive value. A limited amount of good quality alfalfa meal may be desirable in the grain mixture from the feeder's standpoint when no legume hay is fed. The general use of large amounts of ground alfalfa in the grain mixture, however, is not to be recommended.

FEED MIXTURES CONTAINING MOLASSES

Molasses, a by-product from either cane or beet sugar manufacture, is very low in protein but furnishes about three-fourths as much energy as corn. From the standpoint of balancing the ration it is deficient in the same direction as the home-grown grains, and its use will call for still more high-protein supplements to produce a balanced ration. Molasses is valued as a feed chiefly because of its appetizing and conditioning qualities. As a conditioner it ranks with silage, roots, and linseed oilmeal. On account of its great sweetening power a small amount of molasses effects a marked improvement in the flavor of an otherwise unpalatable ration.

Because of its liquid condition and the consequent difficulty of shipping and handling, molasses has not come into wide use among farmers. Molasses diluted with an equal amount of water and sprinkled over the roughage may often be of advantage in encouraging the consumption of roughage of low palatability. Less difficulty is usually encountered by providing a grain mixture fully up to normal in palatability so that the real need for molasses in the grain mixture is small. Molasses can be more readily procured and handled by the feed mixer than by the farmer. It adds to the palatability and popularity of the proprietary mixed rations so its use in this way has become quite general. Molasses has sometimes been used in mixed feeds to mask the presence of inferior and otherwise unsalable feeds. However, many molasses feeds of high quality are found on the market. Its use is shown in Tables 2 and 5.

MINERALS IN THE GRAIN RATION

When legume hay and a grain mixture containing bran and one or more of the oilmeals is fed there is probably little to be gained by including minerals in the ration. Otherwise, equal parts of pulverized limestone, or calcium carbonate, and bonemeal may be desirable to the extent of 1 percent of the grain. Salt is sometimes added to the extent of 1 percent.

EARLY SWEET CORN VARIETY TESTS, 1928

ROY MAGRUDER

Each year a number of new varieties of early sweet corn are offered the public and, as the seedsmen continue to carry the older varieties, the number of varieties listed is now quite large. In many cases the descriptions do not contain a sufficient number of facts to enable the grower to make intelligent selection. To furnish some of these facts is the purpose of this report.

The experiments include samples secured in the spring of 1928 from the catalogs of about one hundred seedsmen. In order to keep the number of samples at a minimum only the specialties of each seedsman were selected and, with few exceptions, only a single sample of each variety was included. Some of the older standard varieties were included for comparison.

Continuous selection and painstaking care are required to maintain a pure variety of sweet corn and unless precautions are taken varieties soon become mixed. Since the better seedsmen are continually striving to find better stocks of seed, it is entirely possible that next year's sample of a variety from a given seedsman may vary from the corresponding sample used in these tests. Size may be expected to vary with environmental conditions but other varietal characters should remain fairly constant.

The seed was planted May 12 in a well prepared Wooster silt loam soil that had received 15 to 20 tons of manure previous to breaking. A broadcast application of 200 pounds of nitrate of soda and 500 pounds of 16 percent superphosphate per acre was made just previous to fitting the land for planting.

Twenty hills of each lot were planted in two adjacent rows. The hills were spaced 3 by 2 feet and as soon as the plants were six inches high they were thinned to two plants in each hill. Shallow cultivation with a single row horse cultivator was continued weekly as long as practical.

The ears were harvested at 3- or 4-day intervals thruout the season. Ears were judged to be ready when the kernels were in late milk or early dough stage. Due to the continued cool weather it was necessary to examine the kernels to determine the stage of maturity.

The ears of each harvest were counted and weighed to obtain the seasonal average weight per ear. Readings were made to nearest .1 pound. The husks were stripped back from each ear

and the number of rows recorded. Number of rows (mode) indicates the row class which contained the largest number of ears. The length and diameter of the ear given in Table 1 is that of the husked ear. Plant and ear heights were secured after harvesting had begun. If fewer than 75 percent of the plants carried a second ear the variety was listed as having 1-2 ears; if 75 percent or more carried 2 ears it was listed as 2 ears.

TABLE 1.—White Varieties Worthy of Trial

Variety	Average ear	Ear		Rows
		Length	Diameter	
	Lb.	*In.*	*In.*	*No.*
Earliest	0.32	5½—6½	1½	8
Gills Early Market	.52	6 —8	1¾—2	12
Early Market	.63	7 —8	1½—1¾	12
Whipples Early	.84	7 —9	1¾—2¼	16

In comparing the number of days from planting to first harvest with that given by G. E. Starr, in Circular Bulletin 105, Sweet Corn, of the Michigan Agricultural Experiment Station, it was noted that it required a much longer time for this crop to mature than it did for either of those which he reports. This difference is largely explained by the environmental conditions for the growing season of 1928.

The soil was relatively dry at planting time, May 12, and only 1.26 in. of rain in light showers fell during the remainder of the month. The monthly amount was 2.23 inches below the 40-year average. The dry soil and low temperature, which was also below the average, were largely responsible for the slow and uneven germination. Some plants were 2 inches high and others just coming up on May 24 when a light frost, altho it did not kill, seriously retarded plant growth.

June continued to be below normal in temperature but with rainfall of 5.17 inches, 1.19 above the average. The plants were small, yellow to bluish green in color and apparently suffered from nitrogen starvation until the middle of June when higher temperatures prevailed. July and August with temperature above normal and plenty of rainfall provided optimum growing conditions.

NOTES ON WHITE VARIETIES

Three of the varieties secured—Earliest Table, Bland's Extra Early, and Extra Early Adams—were not sweet corn. The mature seed was flinty and very hard. This type of grain is capable of

remaining in cold, wet soil for a considerable time without rotting and therefore can be planted earlier than sweet corn with a good chance of securing a stand. There was little difference between these varieties except in earliness. They were characterized by large, vigorous plants varying in position and size of the ear. The ears were usually slightly tapering, covered with heavy, tight husks which did not always cover the end of the ear. They were attached to the stalk by shanks that were hard to snap off.

Pickaninny and Mexican Wonder were found to have some purple colored grains on the ears when allowed to remain on the stalk until they had reached the late dough stage. For the home garden this might not be objectionable but the presence of purple grains would be objectionable to most buyers.

Some varieties had light to dark, wine-red colored seeds. When ears of these varieties, allowed to reach the late dough stage, were cooked it was found that a pink to light brown color developed at the base and in a small dot at the top or crown of the grains. This was most noticeable in the ears with wide spaces between the rows of grain and detracts from the table appearance. Varieties showing this character were Earliest of All, Early Leach, Early Wonder, Red Cob Cory, and Extra Early Dighton.

Earliest of All and Early Leach were identical in appearance, Early Wonder and Extra Early Dighton were also identical and appeared to be later and larger strains of the former. They also had lighter colored seed and from 30 to 50 percent was white. All were characterized by having tapering ears with medium to wide spaces between the pairs of rows of kernels.

Sixty-day Makegood—Vaughn was almost identical with Gills Early Market. Early Surprise—Stark was only slightly later and larger than Early Market—Rice.

Table 3 is a list of all the varieties tested.

SUMMARY

Considered from the market standpoint of both earliness and size the following varieties were selected from this year's trial as representing the largest in each harvest class and deserving of trial. For the home garden where size is not so important and number of ears more important, other varieties than these might be selected.

NOTES ON YELLOW VARIETIES

Banting, the earliest yellow sweet corn tested, ripened 13 days ahead of the Golden Bantam, Harris strain. Many of the ears were as large as the regular strain of Golden Bantam. This variety was originated by the Central Experimental Farms, Ottawa, Ontario, Canada.

The Burpee.—Burpee, varied somewhat in ear size. The slender, 8-row type was the earlier. Only 3 days later than Banting and about 50 percent heavier.

Golden 60-day.—Vaughn, was similar to the Burpee but averaged slightly later, thicker ears, and larger stalks.

Extra Early Bantam.—Harris, was somewhat variable in type, containing a few plants similar to the Burpee. A week earlier than the ordinary Bantam.

TABLE 2.—Yellow Varieties Worthy of Trial

Variety	Average ear	Ear		Rows
		Length	Diameter	
	Lb.	*In.*	*In.*	*No.*
Banting	.27	6 - 7	1¼	8
The Burpee	.41	6½—7	1¼—1¾	12
Golden 60-Day	.49	6 —6½	1½—1¾	12
Sunshine	.51	7 —8	1½	12
Whipples Yellow	.65	7 —9	1½—2	12

Golden Sunshine.—N. D. and Golden Sunrise—Greenfield proved identical. Originated at the North Dakota Agricultural Experiment Station. Uniform, varying slightly in number of rows. Longer and slightly heavier than the previously mentioned yellow varieties.

Nuetta.—Will. Very starchy and not adapted to this locality.

Whipples Yellow.—Harris. The earliest large-ear variety, large enough for most markets.

Buttercup.—Harris. Except for the 10-row-ear plants, it was identical with Bardens Wonder Bantam.

Bardens Wonder Bantam, Ford's strain, was a little larger and later than H-L. A longer and slightly later selection of Golden Bantam.

SUMMARY

The following list of varieties will give a succession of sweet corn thruout the growing season. Where the small, 8-rowed Bantam type is desired and where only one variety is to be grown, the first should be chosen. If larger but medium size is wanted, then one of the next three may be used.

TABLE 3.—Notes on 1928 Sweet Corn Variety Test

Days from planting		77	80	83	86	90	94	98	102	104	108	110	115	Aver. ear wt.	Length of ear	Diameter of ear	Rows (mode)	Rows (range)	Plant height	Ear height	Ears per plant
Date of harvest		7/28	7/31	8/3	8/6	8/10	8/14	8/18	8/22	8/24	8/28	8/30	9/4								
Variety	Seedsman	Percent of total number of ears harvested on each date												Lb.	In.	In.	No.	No.	In.	In.	
White varieties																					
Pickaninny	Will	52	33	15	...	...	...	...	...	...	...	...	...	.237	5 -6½	1¼	8	8-10	30-36	6-8	1
Pickaninny	Ontario	49	11	40	...	...	...	...	...	...	...	...	...	.213	5 -6½	1¼	8	8-10	36-42	6-8	1
Earliest	Vaughan	43	38	19	...	...	...	...	...	...	...	...	...	.325	5½-6½	1½	8	8-10	42-48	12	1-2
Earliest of All	Eberle	7	30	37	19	7	...	...	...	...	...	...	...	.393	6 -7½	1½-1¾	8	8-10	48-52	12	1-2
Alpha	Ferry	7	12	41	31	9	...	...	...	...	...	...	...	.311	6 -7	1¼-1½	8	8-10	54-57	12	1-2
Gill's Early Market	Harris	...	47	33	20	...	...	...	...	...	...	...	...	.522	6 -8	1¾-2	12	8-16	42-48	10-12	1
60-day Makegood	Vaughan	...	38	48	14	...	...	...	...	...	...	...	...	.586	6½-8	1½-2	12	8-14	48-52	12-15	1
Early Leach	Woodruff	...	30	30	25	15	...	...	...	...	...	...	...	.440	6 -7½	1½-1¾	8	8-12	48-54	12	1-2
Snowflake	Isbell	...	25	35	16	14	...	...	...	...	...	...	...	.365	6½-7	1¼-1½	8	8-10	54-60	10-12	1-2
Early Market	Rice	...	19	52	29	...	...	...	...	...	...	...	...	.629	7 -8	1½-1¾	12	8-12	48-52	12-15	1-2
Early June	Will	...	10	52	38	...	...	...	...	...	...	...	...	.300	5½-6	1 -1¼	8	8-12	48	10-12	2
Early Surprise	Stark	...	16	16	22	30	...	16	...	...	...	...	...	.640	6½-8	1½-1¾	12	8-14	60-66	12-15	1
Extra Early Cory	Moore	...	7	21	38	34	...	...	...	...	...	...	...	.573	7 -8	1½	12	8-12	54-60	15-18	1-2
Mammoth White Cory	Ferry	...	...	23	41	18	...	18	...	...	...	...	...	.488	6½-7½	1½-1¾	12	8-12	48-60	10-12	1-2
Early Dakota	Will	...	...	19	34	22	6	19	...	...	...	...	...	.483	6½-8	1½	12	8-12	54-60	12-15	1-2
Early Wonder	Woodruff	...	...	14	63	18	5	...	...	...	...	...	...	.550	6½-7½	1½-1¾	10	8-12	60-66	18	1-2
Extra Early Page	Woodruff	...	...	8	64	12	16	...	...	...	...	...	...	.520	6½-7½	1½	10	8-12	54-60	12-15	1-2
Firstin	Schell	...	...	9	22	41	28	...	...	...	...	...	...	.504	6 -8	1½-1¾	8	8-12	66	18-24	1-2
Verifirst	Johnson	...	...	...	37	48	15	...	...	...	...	...	...	.550	6½-8	1½-1¾	12	8-12	66-72	18-24	1-2
Cupid	Henderson	...	...	...	29	51	20	...	...	...	...	...	...	.261	5 -6½	1 -1¼	12	10-12	54	15	2
Extra Early Dighton	Rice	...	...	...	27	50	23	...	...	...	...	...	...	.592	6 -7½	1½-1¾	12	8-12	60-66	18-20	1-2

Red Cob Cory	Henderson	....	....	....	8	30	32	26	4	...	....	....	...	.584	7 -9	1¼	8	8-12	72	20-24	1-2
Earliest Table	Landreth	....	....	....	7	33	37	16	7	...	....	....	....	.627	7 -8	1½-1¾	12	8-14	72-78	24-30	1-2
Earliest Mayflower	Johnson	....	....	....	3	26	39	26	6	...	....	....	....	.597	6½-8	1½	10	8-14	72	24	1-2
Independence	Salzer	.. .	..	...	4	18	32	23	23	....	....	....	....	.391	6 -8	1 -1¼	8	8	72	18-24	2
Aristocrat	Dreer	....	....	....	...	78	22	....	....	....	...	...	....	.578	7 -8	1½	8	8-12	66	18-24	1-2
Early Dawn	Isbell	....	....	...	.	48	52	....	....	....	...	..	....	.530	6 -7	1¼-1½	12	8-16	72	24-30	2
Whipple's Early	Harris	....	....	....	....	39	41	....	17	3	....	....	....	.844	7 -9	1¾-2¼	16	12-20	84	24-30	2
A & C Early	A & C	....	....	....	....	33	52	15	....	....	....	....	....	.741	7 -9	1½-1¾	12	8-14	72-84	24-30	1-2
Premo	H-L	....	....	....	....	32	60	....	8	....	....	....	....	.724	7 -8	1½-1¾	12	8-12	78	24-30	2
Ford's Early	Ford	....	....	....	....	23	50	17	10	....	..	....	....	.552	7 -9½	1¼-1½	8	8-12	72-78	24-30	2
White Cob Cory	Henderson	....	....	....	....	14	43	37	6	....	....	..	....	.639	7½-9½	1½	8	8-12	72	20-24	1-2
Bland's Extra Early	Woods	....	....	....	....	16	38	30	12	2	2	..	....	.708	7 -9	1¼-1½	12	8-16	84-96	30-36	1-2
Honey Boy	Salzer	....	....	....	....	....	35	27	18	20	..	....	....	.486	8 -9	1¼-1½	12	10-14	84	24-30	2
Extra Early Adams	Landreth	....	....	....	....	....	30	38	26	..	....	....	....	.711	6½-8	1¼-1½	12	12-16	84-96	36-48	1-2
Kendal's Giant	Landreth	....	....	....	....	....	21	24	42	...	8	5	....	.777	7 -9½	1½-2	12	10-16	72-84	24-30	1-2
Metropolitan	Henderson	....	....	..	..	....	2	21	23	9	40	5	....	.800	8 -9	1¾-2	12	8-14	90	30-36	1-2
Nectar	Ford	....	....	....	....	....	....	29	35	18	11	7	..	.732	7 -9	1½-1¾	12	10-14	84-96	36	1-2
Mexican Wonder	Stark	....	....	....	...	....	....	15	48	9	14	14	....	.383	7 -9	1¼-1½	8-12	8-12	72	24	1-2
Branching	Burpee	....	....	...	...	....	....	3	47	24	20	6	....	.357	5 -6½	1¼-1½	12	10-14	72-78	20-30	2-3
Three Ear	Stark	....	....	...	...	....	....	....	9	14	43	14	20	.754	7 -9	1½-1¾	14	12-16	84-96	36	1-2
Yellow varieties																					
Banting	Will	6	31	38	25	....	...	....	....	....	....	....	....	.272	5 -7	1¼	8	8-12	48	10-12	1-2
Banting	Ontario	3	30	30	32	5	...	....	....	....	....	....	....	.273	5 -7	1¼	8	8-12	48	10-12	1-2
The Burpee	Burpee	....	3	36	28	18	....	15	....	....	....	....	....	.408	6½-7	1¼-1¾	12	8-12	54	12-15	1-2
Golden 60 Day	Vaughan	....	....	10	50	40	....	....	....	....	....	....	....	.490	6 -7½	1½-1¾	12	8-14	54-60	12	1-2
Ex. Early Bantam	Harris	....	....	6	43	37	14	....	....	....	....	....	...	.414	6 -7	1¼-1½	8	8-12	48-60	15-18	1-2
Golden Sunshine	N. D.	....	....	5	48	26	21	....	....	....	....	....	....	.495	7 -8	1½	12	8-14	60	12-15	1-2
Golden Sunrise	Greenfield	....	....	7	32	29	32	...	....	....	...	....	....	.515	7 -8	1½	12	8-14	60	12-15	1-2
Nuetta	Will	....	...	....	64	9	27	....	....	....	....	....	....	.382	7 -8	1 -1¼	8	8-10	48-54	10-12	1-2
Whipple's Yellow	Harris	....	....	...	....	34	52	7	7	....	....	....	....	.646	7 -9	1½-2	12	10-16	78	18-24	1-2
Golden Bantam	Harris	....	....	...	....	28	48	11	13	....	..	....	....	.381	6 -7	1¼	8	8	60-66	15-24	1-2
Buttercup	Harris	....	....	..	....	6	39	30	19	6	....	..	....	.470	8 -9	1¼-1½	8	8-10	72-78	18-24	1-2
Barden's Wonder Bant.	H-L	....	....	..	....	8	16	38	38	....	....	....	....	.471	8	1¼-1½	8	8	72-78	20-24	1-2
Barden's Wonder Bant.	Ford	....	....	..	....	....	28	32	40	....	....	....	....	.474	8 -9	1¼	8	8	72-78	20-24	1-2
Golden Sugar	Ford	....	....	..	....	....	....	10	45	...	30	15	....	.745	7 -8	1¾-2	12	10-16	84	24-30	2
Jumbo Gold	Stark	....	....	....	....	....	....	....	52	14	20	6	8	.712	7 -9	1½-1¾	12	10-16	84	24-36	1-2

A HIGH QUALITY TABLE BEET

ROY MAGRUDER

Many new and recently introduced varieties of vegetables are tested by the Experiment Station each year for the purpose of determining their merits under Ohio conditions. A variety of table beet that seems to have all the good qualities accorded it by seedsmen has been under observation for the last three years.

Altho not a new variety, only recently has it been given a prominent place in the catalogs of a few seedsmen as the highest quality table beet. It is known by different names, such as Long Season, Lutz's Green Top, Lutz's Green-Leaf Winter, and The Century.

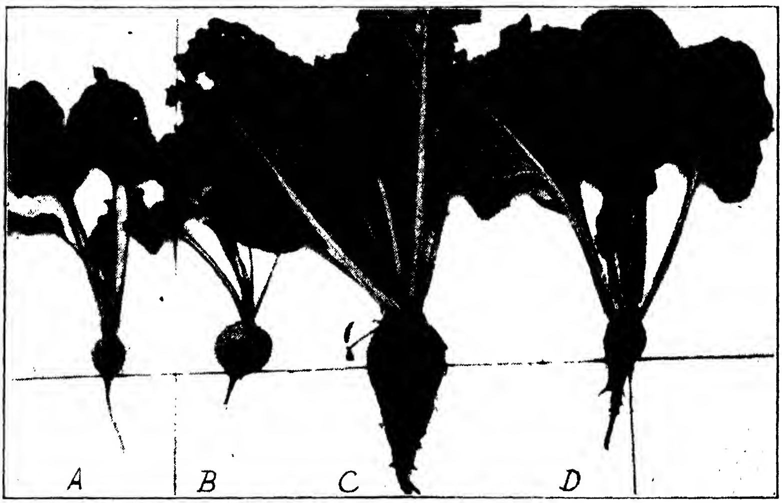


Fig. 1.—A—Young plant of Detroit Dark Red. B—Mature plant of Detroit Dark Red. C—Mature plant of Long Season. D—Young plant of Long Season. Note the comparative size of foliage and root of plants of the same age.

Its chief claim to distinction is that it remains sweet and tender thruout the entire growing season and thruout a fairly long storage period. Beets sown the latter part of May were stored in a barn basement storage until the first of March the following year, at which time they were still relatively free from fiber or strings and of much sweeter flavor than any of the common round varieties. The flesh is of fine texture and almost solidly dark red or purple.

The leaves are large and green in color. The stems show a little light red color. While young, the leaves make a very satisfactory substitute for spinach. When used for "greens" they do not produce a dark color, such as is caused by tops of the red-leaved varieties.

Figure 1 shows the shape of root and character of leaves of both young and old plants. Its long top-shape and the presence of many fine side roots are objectionable from the market standpoint. The buying public will have to be educated concerning its high quality in order to overcome the handicap of poor appearance. A comparison of Long Season with Detroit Dark Red shows that it reaches edible size as soon as Detroit Dark Red and grows much longer. The largest root (Fig. 1) is approximately 4 inches in diameter and 8 inches long.

Because of its larger size it should be given more room in the garden than the early round varieties.

ADD COOKED POTATOES TO CHICKENS' RATION

WEEKLY PRESS BULLETIN

Cooked potatoes make a valuable addition to the ration for winter layers. The abundant supply of potatoes will permit their liberal use, especially of those not up to standard quality.

Raw potatoes are not satisfactory for chickens. For best results, D. C. Kennard, in charge of poultry investigations at the Ohio Agricultural Experiment Station, finds that they must be boiled or steamed so as to be mashed and mixed while hot with that amount of the laying mash that will make a moist, crumbly mixture.

The mixture is fed as a warm mash at noon or in the evening in the amount that the hens will consume in 15 or 20 minutes. This will require 6 to 10 pounds of potatoes daily for each 100 hens.

Potatoes are not to be considered as a succulent green feed, but serve as a substitute for part of the grain which would otherwise be required. They are much relished by the fowls, and when fed as a part of a warm moist mash may stimulate better egg production because of the extra feed consumed.

Four to five pounds of cooked potatoes are considered equivalent to one pound of grain for feeding purposes. They have the advantage of adding variety to the ration, and offer a desirable means of feeding a most palatable warm moist mash during the winter months when most needed to maintain body weight of the birds and keep up egg production.

PORTABLE BROODER HOUSE WITH COMPOSITION BOARD SIDING

D. C. KENNARD

A portable brooder house needs to be light, so that it can be easily moved; tight, so as to conserve heat and protect against wind; and so constructed as to provide insulation against loss of inside heat and keep out much of the sun's heat. It should be designed to take full advantage of direct sunlight, and equipped with effective ventilators for use when weather makes it desirable to close all the windows and the open front spaces.

The brooder house, as shown in Figure 1, was designed by the Ohio Station in order to embody the foregoing points. Either composition board or the usual drop siding can be used in its construction.

There are a number of different types of composition board on the market and some seem to have a place in brooder house construction. However, discretion should be used in making the selection so as to secure the material best suited for the purpose. There are also certain details of construction which need to be followed.

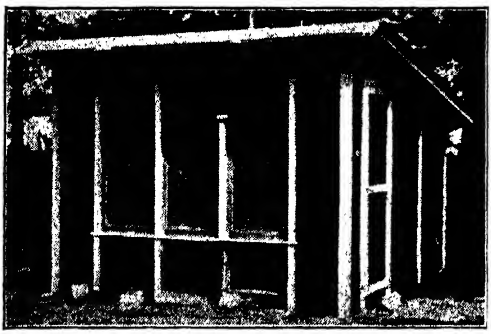


Fig. 1.—Portable brooder house, with composition board siding

It will be observed that this brooder house has more than the usual window space. The windows are easily removable for admission of direct sunlight. The small upper sections of the windows are hinged to the lower ones, and can be tilted inward so as to secure the ventilation desired for moderate weather. Rafter ventilators are provided so as to secure the needed ventilation thru the front and rear rafter spaces, when all the windows and open front space are closed during severe windy or cold weather. With the upper sections of the windows and the rafter ventilators, the ventilation can be controlled for all weather conditions. This arrangement of the windows and the rafter ventilators serves equally well for laying houses.

A fuller descriptive and working plans have been published in Special Circular 14, which can be secured upon request.

THE OPERATION OF LARGE LAND HOLDINGS IN OHIO

P. G. MINNEMAN AND J. I. FALCONER

A study was recently made of the extent and method of operation of large land holdings in several Ohio counties. Information was secured relating to all holdings of over 500 acres in twelve representative Ohio counties, this was found to include 123 holdings comprising a total of 125,262 acres of land. These, holdings varied in size from 500 acres up to 18,000 acres, altho the largest holding of farm land was 4,700 acres. Of these 123 larger holdings only 27 were made up entirely of land in one block. The following table shows how the holdings are operated at the present time.

TABLE 1.—Method of Operating 123 Large Holdings

Methods	Percentage distribution		
	Of land area operated under different methods	Of owners using each method	
		On part or all of land	Exclusively
Owner managed	35	50	24
Hired manager	11	10	4
Hiring labor, total	46	60	28
Cash rent	13	24	7
Crop-share rent	20	36	11
Livestock-share rent	16	30	7
Thirds rent	3	5	0
Renting to tenants, total	52	72	41
Idle	2	....	....

Two distinct tendencies since 1920 in the manner of operating are apparent. A smaller group of owners have turned to the production of specialized products for which a higher price or a special market exists, while the larger group are farming more extensively. One group tends to increase the receipts while the other tries to reduce the expenses. The trend, however, is apparent where buildings are available, to divide up large holdings into smaller units and to operate them with tenants rather than with hired labor. The greatest interest among large land-owners at the present time is in tenancy; in methods of securing favorable contact and cooperation with the tenant operators.

FARM BUSINESS SUMMARIES FOR 1925-26-27

J. I. FALCONER

Since 1910 the Department of Rural Economics has been making financial summaries of the year's business on various Ohio farms. The Bimonthly Bulletin of Nov.-Dec., 1926 carried a summary of 4,666 of these records, including the summaries for the year 1924. The present article includes the summaries for the years 1925, 1926, and 1927, comprising a total of 820 summaries. The data have been compiled from farm account books. Many more records have been summarized during the period but records of all have not been preserved. The data in the table give the principal sources of income as represented by cash sales from these farms; the main sources of income have been arranged in order of importance. The receipts are total cash receipts from sales and do not include non-cash income, such as produce furnished to the farm household by the farm. The expenses are cash farm expenses and do not include as an expense the household or personal expenses, a charge for the farmer's own time or any interest on investment. Labor income is figured by deducting the farm expenses and 5 percent interest on the investment from the receipts. An increase in inventory value of the working capital has been figured as a receipt and a decrease as an expense in computing labor income. There are included in the summaries, 154 farms for the year 1925, 285 for 1926, and 381 for 1927. The farms included are perhaps not altogether typical of the State since they were selected to the extent that the farmers were keeping farm accounts. Neither were they all the same farms each year as some dropped out and others came in.

TABLE 1.—Farm Business Summaries

County	Principal sources of receipts in order of value	Year covered	Farms	Receipts per farm	Expense per farm	Labor income
			No.	Dol.	Dol.	Dol.
Allen	Hogs, cattle, poultry, wheat, dairy	1929	4	4,632	2,052	1,503
	Hogs, poultry, wheat, dairy, cattle	1927	6	3,446	1,425	890
Auglaize	Hogs, dairy, poultry, cattle, wheat	1925	13	3,653	1,850	1,390
	Hogs, dairy, poultry, wheat, cattle	1926	18	3,992	1,656	1,690
	Hogs, dairy, poultry, wheat, cattle	1927	11	3,915	1,494	1,368
Butler	Hogs, poultry, dairy, wheat	1925	13	3,750	1,501	1,850
	Hogs, dairy, poultry, cattle, wheat	1926	8	4,614	1,840	1,019
	Hogs, dairy, poultry, wheat, cattle	1927	13	3,772	1,816	1,003
Clinton	Hogs, cattle, wheat, dairy, cattle	1926	9	6,477	3,200	1,426
Coshocton, Muskingum	Dairy, poultry, cattle, wheat, hogs	1927	8	2,385	782	1,287
Crawford	Hogs, poultry, cattle, dairy, wheat	1927	18	3,553	1,612	617
Darke	Hogs, dairy, poultry, wheat, cattle	1927	9	2,853	931	1,285
Defiance	Poultry, wheat, dairy, hogs, corn	1927	5	5,083	2,030	1,436
Delaware	Dairy, poultry, hogs, wheat, sheep	1927	6	3,233	1,505	842
Franklin	Hogs, dairy, poultry, wheat	1925	32	4,201	1,756	1,812
	Hogs, dairy, wheat, poultry, cattle	1926	23	3,663	1,411	1,586
	Hogs, dairy, wheat, cattle, poultry	1927	47	4,257	1,692	1,221
Fulton	Dairy, poultry, hogs, wheat, cattle	1927	10	2,975	1,015	939
Guernsey	Dairy, poultry, sheep, cattle, misc., hogs	1925	17	1,988	950	726
	Poultry, dairy, cattle, sheep, hogs	1926	13	2,067	842	868
	Dairy, poultry, misc., sheep, cattle, hogs	1927	20	1,982	1,033	594
Hancock	Hogs, sheep, wheat, dairy, cattle	1926	10	3,560	1,375	1,265

TABLE 1.—Farm Business Summaries—Continued

County	Principal sources of receipts in order of value	Year covered	Farm	Receipts per farm	Expense per farm	Labor income
			No.	Dol.	Dol.	Dol.
Henry	Hogs, poultry, corn, wheat, dairy	1925	15	4,155	1,353	1,592
	Hogs, wheat, poultry, sheep, dairy	1926	12	4,049	1,284	1,614
	Wheat, hogs, sheep, poultry, dairy	1927	9	4,466	1,660	833
Huron	Dairy, sheep, hogs, wheat, cattle, poultry	1925	15	5,712	3,218	1,745
	Dairy, hogs, wheat, cattle, sheep, poultry	1926	18	4,726	2,302	1,647
	Dairy, wheat, hogs, sheep, cattle, poultry	1927	16	5,506	2,697	1,090
Jefferson	Dairy, poultry, sheep, cattle	1926	6	3,898	1,820	1,199
	Dairy, poultry, cattle	1927	5	3,288	1,595	852
Knox	Sheep, hogs, poultry, dairy, wheat, cattle	1926	16	2,626	1,018	780
	Dairy, hogs, sheep, wheat, cattle, poultry	1927	33	2,744	1,188	563
Logan	Hogs, dairy, sheep, cattle, poultry	1926	10	4,222	1,900	1,473
Madison	Hogs, wheat, cattle, sheep, poultry	1927	9	3,077	1,384	536
Medina	Dairy, poultry, cattle, wheat, hay	1926	7	4,315	2,662	426
	Dairy, poultry, cattle, sheep, wheat	1927	8	4,545	2,223	971
Mercer	Hogs, poultry, dairy, wheat	1925	10	3,043	1,464	1,332
	Hogs, poultry, wheat, dairy, cattle	1926	10	3,494	1,524	1,591
	Hogs, poultry, wheat, dairy, cattle	1927	6	3,401	1,650	3,520
Montgomery	Hogs, tobacco, dairy, corn, poultry	1926	9	3,641	1,473	1,060
	Hogs, dairy, tobacco, wheat, poultry	1927	14	2,340	936	549
Morgan	Poultry, dairy, sheep, cattle, hogs, misc	1927	6	1,455	601	353
Paulding	Hogs, dairy, poultry, wheat, cattle	1926	12	3,854	1,519	1,530
	Hogs, dairy, corn, poultry, oats	1927	7	5,354	2,220	372
Portage	Dairy, poultry, cattle, hogs, wheat, sheep	1926	8	1,904	1,027	176

TABLE 1.—Farm Business Summaries—Concluded

County	Principal sources of receipts in order of value	Year covered	Farms	Receipts per farm	Expense per farm	Labor income
			No.	Dol.	Dol.	Dol.
Preble	Hogs, dairy, cattle, poultry, wheat	1927	18	3,518	1,332	1,225
Putnam	Hogs, dairy, beets, poultry, wheat	1925	20	3,566	1,478	911
	Hogs, wheat, dairy, cattle, poultry	1926	31	4,752	1,925	1,517
	Hogs, cattle, dairy, wheat, poultry	1927	20	4,915	2,428	559
Sandusky	Hogs, dairy, wheat, poultry, potatoes	1926	6	4,404	1,808	1,721
Scioto	Dairy, poultry, cattle, potatoes, hogs	1925	13	2,640	1,388	430
	Dairy, cattle, poultry, truck, wheat	1926	9	2,779	1,307	850
	Dairy, cattle, hogs, poultry, truck	1927	7	2,824	1,591	666
Seneca	Hogs, poultry, wheat, dairy, cattle	1926	13	2,865	982	929
	Hogs, poultry, dairy, wheat, cattle	1927	8	3,180	1,357	646
Summit	Dairy, poultry, hogs, cattle, potatoes	1926	9	4,280	2,556	1,066
	Dairy, poultry, cattle, wheat	1927	8	4,502	2,356	923
Trumbull	Dairy, poultry, cattle	1926	5	2,145	1,295	489
	Dairy, poultry, misc., cattle, potatoes, hogs	1927	12	3,150	1,577	866
Warren	Hogs, dairy, cattle, corn, poultry	1926	9	5,119	2,628	493
	Hogs, cattle, dairy, wheat, poultry	1927	18	4,584	2,728	855
Wayne	Wheat, dairy, poultry, cattle, hogs, sheep	1925	6	4,438	1,942	1,549
	Wheat, dairy, hogs, poultry, cattle, sheep	1926	6	3,247	1,279	1,230
Williams	Poultry, hogs, dairy, cattle, wheat	1926	4	3,208	1,106	1,395
	Hogs, poultry, dairy, wheat, cattle	1927	8	3,828	1,357	532
Wood	Cattle, hogs, wheat, dairy, corn, beets	1927	16	5,353	3,012	1,073

INDEX NUMBERS OF PRODUCTION, PRICE, AND INCOME

J. I. FALCONER

The crop year of 1928 was not unusually successful for Ohio farmers. The corn crop was slightly less than normal. The wheat crop was disappointing, yielding only 9,713,000 bushels, 27 percent of the five-year average, there having been only one smaller crop in the past 60 years.

On the other hand the oat production of the State has been exceeded only once before. The barley crop was also unusually large, 8,335,000 bushels, or twice that of 1927, which was the largest previous crop on record. The hay crop was about 10 percent less than normal; while the potato crop was nearly 10 percent larger than normal but low in price. The tobacco crop, 29,600,000 pounds, was the second lowest for the past 30 years the crop having been less in 1927. The sugar beet crop was less than the five-year average.

For the month of October heavy livestock marketing, especially of hogs, raised the income materially over that of September.

Trend of Prices and Wages, 1910-1914=100

	Wholesale prices all commodities U. S.	Weekly earnings N. Y. state factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm products prices	Ohio cash income from sales*
1913	102	...	100	100	104	100	104	...
1914	100	100	101	102	102	102	105	...
1915	103	101	106	100	103	107	106	...
1916	130	114	123	117	113	113	121	...
1917	181	129	150	176	140	119	182	...
1918	198	160	178	200	175	131	203	...
1919	210	185	205	209	204	135	218	...
1920	230	122	206	205	236	159	212	154
1921	150	203	156	116	164	134	132	90
1922	152	197	152	124	145	124	127	88
1923	156	214	153	135	166	122	134	95
1924	152	218	154	134	165	118	133	95
1925	161	223	159	146	165	110	159	98
1926	154	229	156	136	170	105	155	108
1927	149	231	154	131	173	99	147	94
1927								
January	150	232	...	126	172	...	145	102
March	148	234	154	126	...	99	144	93
July	147	228	...	130	174	...	147	103
August	149	231	...	132	...	...	149	99
September	152	233	154	140	...	...	149	83
October	152	231	...	139	175	...	150	88
November	152	226	...	137	...	...	149	88
December	152	233	153	137	...	...	145	90
1928								
January	151	230	...	137	158	...	141	96
February	151	230	...	135	...	...	141	87
March	150	233	155	137	...	98	146	87
April	152	227	...	140	172	96	152	85
May	154	230	...	148	...	...	167	98
June	153	232	156	145	...	...	164	105
July	154	230	...	145	173	...	163	92
August	155	231	...	139	...	...	158	87
September	157	234	...	141	...	...	159	83
October	...	...	...	...	174	...	154	96

*Average month 1924, 1925, and 1926=100.

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Ohio Agricultural Experiment Station

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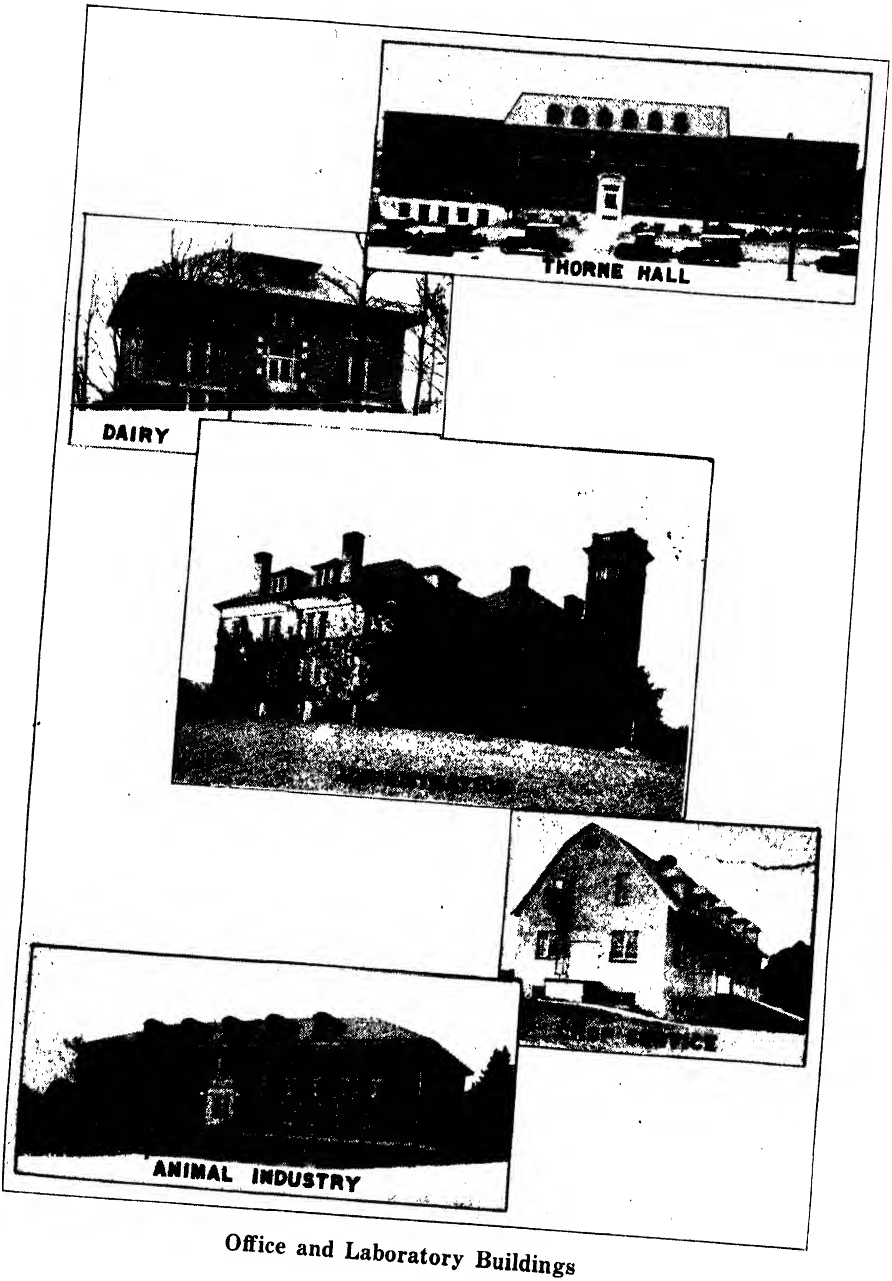
Wooster, Ohio, U. S. A.



Office and Laboratory Buildings

WATER-HEMLOCK POISONING TO LIVESTOCK

B. L. WARWICK AND H. A. RUNNELS

It has long been known that plants of the genus *Cicuta*, or water-hemlock, are poisonous to man and to most, if not all, classes of farm animals. Two species of this genus are found in Ohio, both limited to moist areas, such as wet pastures, swamps, and borders of ditches and ponds. On July 1, 1928, about 125 head of sheep and lambs at this Station were placed in a pasture which was afterwards found to contain a large patch of water-hemlock. On July 13 one mature ewe became sick with symptoms pointing to poisoning and died two days later. The plants were identified as spotted water-hemlock, *Cicuta maculata* L.; and the sheep were removed from the pasture until after the plants were dug out.

Careful work with another species of this genus, *Cicuta occidentalis* Greene, reported by Fleming and associates, in Nevada Experiment Station Bulletin 100, showed that the stems, leaves and shoots are dangerous only when they first appear in early spring.

At the time the animal became sick at this Station the plants were in bloom. However, there were also a few newly formed shoots. All of these new shoots, amounting to approximately three ounces, were gathered and fed to a yearling sheep. An equal quantity of matured leaves was fed to another sheep. In each case the material was fed from the hand so as to be sure that every particle was consumed. Neither individual showed any noticeable symptoms.

Two days later, fresh tubers were given to the same animals, in order to determine whether this species was as deadly as believed. Owing to the unpalatable nature of this material, the tubers were cut into small pieces, placed in half ounce gelatine capsules and given to the animals. One animal received three ounces, but showed no symptoms of poisoning. The other received six ounces, dying about four hours later with typical spasmodic symptoms. On autopsy of the poisoned animal, the pieces of tubers were found in large quantities in the paunch and honeycomb and fairly plentifully in the true stomach. The relatively large dose needed to cause symptoms must depend upon the amount of the tubers that reach the true stomach at one time, as the true stomach is the first point where absorption can take place.

The question arose as to whether the young shoots would be poisonous if they went directly to the true stomach. In order to test this, a fresh supply of new shoots was obtained. These had sprung up during the short interval since the first feeding of shoots. Approximately $1\frac{1}{3}$ ounces were cut up into small pieces and placed in half-ounce gelatine capsules. An area about five inches long on the belly of another sheep was clipped and disinfected and an incision made parallel to the median line. The abdominal cavity was opened and the abomasum, or true stomach, was located and brought partially thru the incision. This was incised just enough to admit the half-ounce capsules which contained the shoots. The incisions were sutured immediately after the capsules were inserted. No symptoms of water-hemlock poisoning ensued.

Fig. 1.—Spotted Water-hemlock *(Cicuta maculata* L.*)*

a. Showing transversely chambered base of stem and cluster of fleshy tubers.
b. Fruit composed of a pair of carpels joined along flat side.
c. Single carpel.
d. Cross-section of carpel showing dark brown oil-tubes between the corky ridges.

So far as the writers are able to determine, no direct evidence as to the susceptibility of swine has been recorded for this species of hemlock. The cases that have been reported are meager, not recent, and concern European species of this plant. Accordingly, a suckling pig was given one ounce of the tubers in 000 capsules. The pig vomited a small amount of the material soon after it was given. About four hours later the pig showed spasmodic symptoms, went into convulsions, and died.

These tests contribute, to a certain extent, to the knowledge of the poisonous nature of this species. Sheep and swine were found susceptible to the poison present in the tubers. We were not able to demonstrate any poisonous properties in the young shoots by feeding tests with the amounts of the material available. If they are poisonous in midsummer it must be only under very special circumstances, about which we have no knowledge. The parts

above ground do not appear to be highly dangerous at this season, but doubtless are dangerous in the early spring, as is known to be the case with other species of this genus.

The description and accompanying figure will aid in identifying spotted water-hemlock (*Cicuta maculata* L.).* The fleshy tubers, not unlike very small sweet potatoes in appearance, are clustered around the stem-base, which is somewhat swollen and has transversely chambered pith. Stem is smooth, stout, erect, branched, 2 to 6 feet tall, hollow except at the nodes and marked with purplish lines that are more pronounced in color at the junction with the branches. Leaves alternate, pinnately decompound, on petioles with dilated, sheathing bases; leaf-segments lance-shaped, coarsely and sharply toothed with the veins ending in the notches instead of the points. Flowers in compound, umbrella-like clusters with the stalks of the secondary clusters unequal in length giving them an uneven appearance; calyx toothed; petals small, white, broad, and turned inward at the tips; fruits smooth, oval in shape, composed of two carpels joined along their flat sides, later separating into boat-shaped halves with 5 corky ribs alternating with 4 oil-tubes on the convex side and 2 oil-tubes on the flat side.

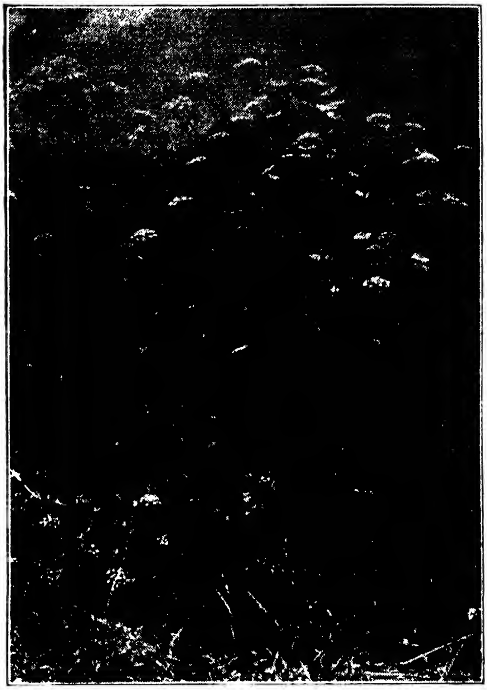


Fig. 2.—Spotted Water-hemlock (*Cicuta maculata* L.), growing in a low wet spot in a pasture

Another species, bulb-bearing water-hemlock (*Cicuta bulbifera* L.) is less common in Ohio altho it has the same poisonous properties. The stems are shorter and more slender; leaf-segments are linear in shape, sparingly toothed, and the upper leaves bear small bulblets in their axils.

*Suspected plants will be identified if forwarded to the Department of Botany, Experiment Station, Wooster, Ohio. The specimen should include the entire plant, carefully wrapped to prevent drying during transit.

SULFUR DUSTS FOR THE CONTROL OF APPLE SCAB

H. C. YOUNG

Each year there are numerous requests for the latest information on dusting versus spraying for the control of apple diseases. The growers are always given about the same answer, and that is, "dusting is to be recommended, with several reservations." Even tho almost all of the fruit-growing states have experimented extensively with dusting, it has not become general and there are today very few unqualified recommendations for its use.

The results of the dusting experiments in Ohio have been about the same as in other states. Failures and successes in almost equal numbers have been recorded. In some seasons dusting has seemed to work, especially in some sections, while in others it has failed almost completely. After five years of experimentation with sulfur dust for the control of apple diseases it is concluded that better dusts must be made before dusting can be expected to take the place of spring and summer spraying. The cause of the failures of dust can be attributed to one or both of two factors; either it is not sufficiently toxic or it is removed by rains. The work of the past five years has been an attempt to determine just what is wrong and if possible to build a dust that will eliminate such defects.

The first point which will be discussed here is the effect of rain on the removal of the sulfur dust. Both laboratory and field tests were made. The field tests were conducted in two orchards, one seven years of age, and the other three. In the older orchard the trees were dusted with a Bean self-mixing power duster and in the younger orchard with a Peerless hand duster. The younger orchard proved the more satisfactory in that all the leaves were exposed and, consequently, gave a better indication of the adhesiveness of the sulfur-dust combination. In each case, the dusts were applied ahead of a predicted rain period. Leaves were removed before and after each rain and the amount of sulfur sticking determined chemically in the laboratory. The dust combinations used were several that had shown promise in the laboratory, by toxicity tests, and in the field. The formulas and the amount of sulfur sticking are given in Table 1.

This table is one of several and is representative. It shows that a rain of 0.66 inch removes from 66 to 94 percent of the sulfur. Heavier rains remove 90 percent, or more. Further examination of these figures shows that when a normal amount of dust is applied to a tree and 80 percent washes off, there is not enough remaining to protect well. Moreover, microscopical examination shows that the sulfur remaining is largely along the veins and most of the leaf is entirely unprotected. It would seem, therefore, that one of the causes of sulfur-dust failure is its being removed from the leaves and fruit. Further experiments along this line were made in the Chardon orchards. In the spring of 1927 an attempt was made to time the dust applications and then to keep a good covering of dust on thruout the infection period. The results are given in Table 2.

TABLE 1.—Sulfur Present on 150 Leaves Before and After Rain

Treatment	Amount put on before rain	0.66 in. rain		2.18 in. rain	
		Washed off		Total washed off	
	Grams	*Grams*	*Pct.*	*Grams*	*Pct.*
90 Sulfur 10 arsenate of lead	1.5244	1.0088	66.1	1.3294	89.9
80 Sulfur 10 lime 10 arsenate of lead	.8079	.6375	78.9	.7100	87.9
Kolotex	1.5546	Lost	Lost	1.4414	93.0
Lime-sulfur spray 1-50	.1261	.0345	27.3	.0831	65.8
80 Sulfur 10 dry lime-sulfur 10 arsenate of lead	1.2925	1.2181	94.2	1.2375	95.5
75 Sulfur 10 dry lime-sulfur 10 arsenate of lead 5 bentonite	.9332	.7678	83.1	.8804	95.6
75 Sulfur 15 dry lime-sulfur 10 arsenate of lead	1.0343	.8928	86.3	.9645	93.2
75 Sulfur 10 dry lime-sulfur 10 arsenate of lead 5 lime	1.5043	1.3491	89.7	1.4599	96.7

TABLE 2.—Results of Field Tests With Sprays and Dusts

Material	Schedule	Scab, percent
Lime-sulfur 1-40	Regular	40
90-10 sulfur-lead arsenate dust	Regular	60
90-10 sulfur-lead arsenate dust	Regular and then twice during bloom the infection period	10
Check	No spray	90

In 1927 the major infection period of the apple scab fungus came in late bloom. The blooming period was also rather long, and the lasting effectiveness of sprays and dusts applied before bloom was insufficient for protection. In 1928, this same scheme was followed in the Bingham orchards at Chardon, and good control of scab was obtained thruout.

The second point, toxicity, has been studied quite extensively. In 1928, several promising dusts were tried in three widely separated orchards in the State. The results of the test in southern and central Ohio were negative in that all materials used controlled scab. The disease was not severe and the ordinary sulfur dusts were effective. The test at Chardon was quite different. Scab was severe and difficult to check and the various dust combinations differed widely in their effectiveness. The dusts were applied as they were needed to insure covering, in all seven applications. The dust combinations used were as follows:

Sulfur dust, 300 mesh ground roll sulfur
Sulfur, Koppers sulfur, 75-25
Sulfur, Manganar, 96-4 and 90-10
Sulfur, $KMNO_4$, 97½-2½
Sulfur, $KMNO_4$, 99-1
Sulfur, dry-lime-sulfur (specially ground) 90-10 and 85-15
Sulfur, dry-lime-sulfur (specially ground)+Bentonite 85-10-5
Sulfur, dry-lime-sulfur (specially ground)+hydrated lime 85-10-5

For post-blossom applications 10 pounds of arsenate of lead replaced 10 pounds of sulfur in each except the Manganar. The results are given in Table 3.

TABLE 3.—Results of Field Tests With Sulfur Dusts

Treatment	Fruits counted	Moderate scab	Severe scab	Total scab	Total scab July 10	On leaves July 10
	No.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
S—Koppers S. 75-25	633	7.6	3.9	11.5	11.0	4.2
Kolodust	655	17.4	4.4	22.1	20.3	9.0
S.	1,262	15.5	8.4	23.9	14.0	9.6
S—Manganar, 96-4	675	4.8	2.5	7.3	1.3	1.6
S + $KMNO_4$, 2½%	602	3.6	2.5	6.1	10.0	2.2
S + $KMNO_4$ 1%	726	8.4	3.0	11.4	12.2	4.4
S + DLS, 90-10	619	11.6	3.0	14.6	5.3	10.9
S + DLS, 85-15	708	2.2	2.2	4.4	2.3	1.75
S + DLS + lime, 85-10-15					10.3	2.6
S + DLS + Bentonite 85-10-5					13.0	6.5
Check				98.5	96.5	39.2

The reason for taking records on July 10 was that the potassium permanganate mixture gave rather severe injury and the Manganar slight injury and were discontinued at that time and a regular commercial dust substituted.

The results of the test show that three of the dusts gave excellent control. The 85-15 sulfur dry-lime-sulfur was exceptionally promising and gave no injury. The 75-25 sulfur-Koppers sulfur, while slightly less effective, was an excellent dust. The sulfur-Manganar mixture was very effective, but gave slight injury to the foliage. It will be experimented upon another season. In all probability, these three dusts will be on the market the coming season. These results are for one season and, while the dusts were found to be very promising, their general recommendation should await further trial.

GENERAL RECOMMENDATIONS FOR THE CONTROL OF APPLE SCAB WITH SULFUR DUSTS

1. In sections where apple scab is not too severe dusting can safely replace spraying.

2. Where scab has been held in check in the pre-blossom period by sprays, dusts may be used in subsequent applications.

3. Dusts may be used on varieties somewhat resistant to scab, such as Grimes, Jonathan, Baldwin.

4. Dusts without poison may be used for blossom application. Frequently scab spores are discharged during bloom and an application of dust will insure control.

5. Dust applications should be carefully timed and applied frequently during rain periods. It is sometimes advisable to dust immediately after heavy rains.

6. Dust both sides ahead of infection periods.

7. Use the best dust obtainable. The finer the dust, the better it will stick. The following formulas for dust mixture are suggested in order given:

   (a) 85-15 sulfur dry-lime-sulfur.

   (b) 90-10 sulfur-Manganar.

   (c) 75-25 sulfur-Koppers sulfur.

   (d) Sulfur, 300 mesh ground roll, or the standard commercial mixture.

COMBINATION INSECTICIDE AND FUNGICIDE SPRAYS

For Dormant and Delayed Dormant Spraying in Ohio

C. R. CUTRIGHT

The title is meant to include the mixing and application of the dormant strength oil and lime sulfur sprays. Some discussion of the mixing of oils with other sprays, such as dry lime-sulfur, bordeaux, and soluble sulfur is also included.

The combination oil- and lime-sulfur spray was developed and has been used principally by the citrus industry. Here, of course, the dilutions used correspond more nearly to the strengths of our summer sprays. Apple growers have never used such sprays to any extent, tho they have been tried in Ohio, Indiana, Illinois, and particularly in the Ozark region of Missouri and Arkansas. Bordeaux-oil sprays have been used in Missouri, Illinois, Ohio, and Indiana, while combinations of soluble sulfur with various oils have been tried in Ohio and some eastern states.

The idea back of the use of such sprays is to combine in one spray application a strong insecticide, represented by the oil, and a fungicide, represented by any of the other materials named. As any one of the materials may cause injury to the trees under certain conditions, the question arises as to what effect such materials in combinations may have on the tree.

Citrus trees apparently suffer little injury from weak dilutions. In Missouri serious injury to apple foliage and buds from the use of dormant strength combinations has been observed. Little information has been reported from elsewhere, except that it has been generally observed that the fungicidal and insecticidal properties of the respective materials do not seem to be appreciably changed by the combination.

During certain seasons in Ohio it is desirable that a combination spray be used on apple trees. For example, it has been shown by Dr. H. C. Young and his co-workers that in some seasons the maturing and discharge of scab spores may take place as early as the period of the delayed dormant spray. During such seasons and in orchards heavily infested with red mite eggs a combined oil and fungicide spray is desirable, since otherwise two separate applications are required. There are also other conditions under which the use of such a spray would be an advantage.

Without entering into a technical discussion of the factors that make for compatibility among sprays we may say that the general groups of oil sprays and the materials with which they can be mixed are as follows: 1. The majority of oil emulsions and miscible oils are compatible with bordeaux mixture and soluble sulfur. There are some exceptions to this rule, however, and the directions of the manufacturer usually make this quite definite. 2. Oil sprays, both emulsions and miscible oils that are emulsified or stabilized with soap or ammonia can not be used with liquid or with dry lime-sulfur. 3. Oils emulsified with water soluble colloids, such as milk, starches, flour, glue, gelatin, and casein or with insoluble colloids, such as colloidal clays and Fuller's earth, can usually be mixed with the lime-sulfur.

The data herein reported were taken incident to other experiments and have been in process of collection for five years. They relate principally to the effect that such spray mixtures have on the foliage and buds at or soon after the time of application rather than the effect on various insects with which the experiments primarily dealt.

During the seasons of 1925 to 1928 inclusive, oil and fungicides in combination were tried in orchards at Wooster, Catawba Island, Delaware, Marietta, Chagrin Falls, and Chardon.

Summarized notes on the materials used and the results follow:

Bordeaux mixture 2-4-50 and Sunoco oil spray 2½-50 (2 plots). This material formed an excellent mechanical mixture and when applied to trees just as the first leaves were about ¼-inch long gave no burning of commercial importance.

Bordeaux mixture 2-4-50 and Engine oil emulsion 2¼-50 (4 plots). The combination of these two materials gave additional stability to the Engine oil emulsion. Some of the plots were sprayed when the first leaves were from ½ to ¾ inch in length, without any commercial injury.

Soluble sulfur 4 lb.-50 and Engine oil emulsion 2¼-50 (2 plots). These materials mixed well but rather severe burning resulted when the combination was applied after the leaves had started to unfold. It should not be used except in the dormant period.

Soluble sulfur 4 lb.-50 and Sunoco oil spray 1-20 (3 plots). An excellent mechanical mixture but safe for general use only in the dormant period. When leaves were unfolded about ½ inch it gave severe burning.

In general the four combinations given above were better and more stable mixtures than the lime-sulfur combinations, which follow.

Lime-sulfur (dry) from 4 lb.-50 to 15-50. Colloidal clay oil emulsion (homemade) 2¼-50 (4 plots). These materials mixed fairly well and were used without serious burning up to the time that leaves were ½ inch in length.

Lime-sulfur (dry) 15 lb.-50. Medina oil emulsion 3⅛-50 (1 plot). In one trial this combination was satisfactory on Jonathan when the leaves were about ¼ inch long.

Lime-sulfur (dry) 15 lb.-50. "Emulso" (oil spray of the Peninsular Oil Company of Florida) 1-50 and 1½-50 (4 plots). One of the best oils that we used for mixing with lime-sulfur. "Emulso" is manufactured in Florida where it is used for citrus spraying. Trials of it on apple were satisfactory for the dormant and early delayed dormant period.

Lime-sulfur (liquid) 1-8, Rex spray oil (1928 formula) 1½-50 (2 plots). This oil was also used with dry lime-sulfur in one trial. It mixed very well and was used satisfactorily on leaves ¼ inch expanded.

Lime-sulfur (liquid) 1-40 and 1-8, "Kayso" cold mix oil emulsion 1½- to 2¼-50 (4 plots). The oil emulsion when freshly made mixed very well. It has been used commercially by some growers without any ill effects. In plot work it was satisfactory up to the time that leaves were ½ inch long.

Lime-sulfur 1-7, Colloidal clay emulsion (homemade) 2¼-50 (2 plots). Mixed well with constant agitation and was satisfactorily used while trees were in the late dormant. We have never used it on opened foliage.

The conclusion that may be drawn from these notes is that most of the materials may be safely used up to the time when the first leaves are ¼ inch in length. It is recognized that the usefulness of such sprays as those described above is limited to a very short space of time. However, conditions justifying the use of combined insecticidal and fungicidal sprays do occasionally occur, and it is important to know that such combinations may be prepared and used safely, within the limits as described above.

RATE AND DATE OF SOWING OATS

H. L. BORST*

The oat crop in Ohio is generally produced at a small margin of profit. Because of this fact any practice that leads to increased yields without increase in cost of production is important. That early seeding of oats at the proper rate produces the best yields is fairly well appreciated. Tests conducted on The Ohio State University farm on date and rate of sowing oats furnish new information on this problem for south central Ohio.

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The tests were begun in 1923, Fulghum, an early oat was used as the main variety. In 1925 Miami, a later variety, was added to the experiment. Either fall-plowed or corn ground, put in shape by disking and harrowing, was used. The seedings were made each year at regular intervals, beginning as early as possible and ending about May 1. Since 1924 the desired interval between seedings has been ten days. In 1923 the first possible sowing date was so late that only one other sowing was made. Circumstances prevented seeding on May 1, 1924 and March 20, 1927.

TABLE 1.—Date of Planting Oats

Year and dates of sowing		Yields in bushels per acre: Fulghum	Miami
1923	April 18	36.0	....
	May 1	26.1	....
1924	April 9	84.0	....
	April 16	82.9	....
	April 25	75.6	....
1925	March 21	51.5	....
	April 1	53.1	....
	April 11	60.7	....
	April 20	52.1	....
	May 1	45.1	....
1926	April 15	36.1	42.6
	April 25	34.5	38.5
	May 4	33.4	34.1
1927	March 11	65.1*	55.1*
	March 30	53.6	53.4
	April 10	46.7	46.4
	April 20	42.1	45.3
	May 2	20.0	32.7
1928	March 24	77.7	61.7
	April 2	68.7	57.9
	April 10	68.6	58.0
	April 19	34.8*	24.2*
	May 1	46.7	36.4

*Oats sown at 8 pecks per acre except those marked *, which were sown at 10 pecks.

Thruout the test Fulghum was sown at the five rates indicated in Table 4, on all dates with the exception of the first in 1926 and the second and fourth in 1927. The purpose was to ascertain the best rate of sowing the variety and also whether or not this optimum rate varies with the date of sowing.

Because of the wide range in the first sowing dates of the several years it has not been feasible to average the results obtained. The yields for the different dates of sowing are given in Table 1.

DELAYS IN SOWING DECREASE YIELDS

In order to show more clearly the trends of the yields the average daily decreases from delayed sowings have been calculated for certain periods and are presented in Table 2.

The effect of seasonal differences upon the yields of grain is fully as evident as the effect of the dates of sowing. In the backward season of 1923 the first possible sowing date was April 18. The calculated daily decrease in yield of Fulghum oats computed from the yields obtained on April 18 and May 1 was 24.3 pounds. That is, each day's delay in planting after April 18 resulted in a loss of ¾ bushel per acre. As would be expected from late sowing, the yields of that year were low.

TABLE 2.—Calculated Daily Loss From Delayed Planting of Oats, Pounds per Acre

Crop	1923	1924		1925		1926		1927		1928	
	Apr. 18 to May 1	Apr. 9 to Apr. 16	Apr. 16 to Apr. 25	Mar. 21 to Apr. 11	Apr. 11 to May 1	Apr. 15 to Apr. 25	Apr. 25 to May 4	Mar. 11 to Apr. 10	Apr. 10 to May 2	Mar. 24 to Apr. 10	Apr. 10 to May 1
Fulghum..	24.3	5.0	26.0	14.0	25.0	5.1	3.9	19.6	38.8	17.1	35.0
Miami.....	....	....	....	....	....	13.1	15.6	9.3	19.9	7.0	32.9

The season of 1924, tho not early, was favorable for oat production; cool moist weather prevailed during the growing period. As a result yields were large. The daily decrease from delayed seeding from April 9 to 16 was 5 pounds and from April 16 to 25 was 26 pounds.

The season of 1925 was characterized by a very light rainfall during April, May, and the first half of June, and an intense warm wave during the first nine days of June. These weather conditions were clearly reflected in the yields obtained. The early seedings, hastened by the dry warm weather, ripened prematurely, whereas the seedings made April 11 and thereafter profited by the rains which came before the oats in these seedings filled. Prior to April 11 there was a progressive increase in yield, and after this date there was a calculated daily decrease of 25 pounds.

The season of 1926 was characterized by lateness, light rainfall, and low temperatures until July. The lateness and light rainfall doubtless account for the low yields of the early seedings while low temperatures may account for the comparatively good yields of the later seedings. The daily decreases for Fulghum and Miami after April 25 were only 3.9 and 15.6 pounds, respectively.

In 1927 it was possible to make the first seeding on March 11, but none after that until April 1. The season was normal. The calculated daily loss in yield from delay in sowing between March 11 and April 10 was 19.6 pounds, and between April 10 and May 1, 38.8 pounds.

The season of 1928 was characterized by a subnormal rainfall during April and May, and the month of June was the "fourth coolest and second wettest June in 46 years." The effect of the cool, wet June was reflected in the comparatively good yields produced by the last seeding. The low yields of the April-20 seeding are explained by the fact that, with the exception of a heavy rain on April 21 and 22, this sowing received a total of less than 1 inch of rain until May 28. The calculated daily decreases were 17.1 and 35.0 pounds for Fulghum, and 7.0 and 32.9 for Miami. These figures are far different from those of the previous season for the same periods.

With the exception of the early seedings in 1925, the experiment shows decreases in yield with every delay in sowing. Since the warm period in June 1925, reported by the Weather Bureau as "almost unprecedented", resulted in the low yields of the early seedings, the yields of these seedings may be regarded as abnormal. It is to be noted that the penalty for delay in sowing increased as the season progressed, and after April 10 amounted to more than a bushel a day. At this period a slight delay in sowing may easily wipe out entirely the margin of profit over the cost of production.

LATE SEEDING LOWERS THE QUALITY OF THE GRAIN

Along with the decrease in yields from successively later sowing there was a decrease in weight per bushel. Again it was not possible to average the data on this point for all the years, as the sowing dates did not coincide. Table 3 gives the data for two

TABLE 3.—Test Weight per Bushel of Oats From Different Dates of Sowing

Dates sown ☛	March 11 and 24	April 1	April 10	April 20	May 1
Fulghum, 1927	35.4	....	....	....	27.7
Grade	1	....	....	....	3
Fulghum, 1928	31.0	30.0	29.1	28.6	26.7
Grade	2	2	2	3	3
Miami, 1927	35.7	32.9	31.8	28.9	25.8
Grade	1	1	2	3	3
Miami, 1928	32.4	29.9	29.0	28.1	26.8
Grade	1	2	2	3	3

years. It will be noted that the decrease in weight per bushel of each variety was sufficient to lower the market grade from Number 1 to Number 3.

OPTIMUM RATE OF SOWING FULGHUM OATS

The yields of Fulghum oats sown at five different rates are given in Table 4. The six-year average shows little difference between total yields of the 6-, 8-, 10-, and 16-peck rates. If net yields are considered the 8-peck rate had a slight advantage. A 6-peck rate was very nearly a full seeding. If the crop is desired primarily for a nurse crop, no more, and perhaps less, than this amount of seed should be sown.

TABLE 4.—Rate of Sowing Fulghum Oats, 6-Year Average Yields in Bushels per Acre

Date and rate used	1923	1924	1925	1926	1927	1928	Average	Net yields, seed deducted
First seedings Mar. 21-Apr. 18								
4 pecks	29.0	82.2	41.9	23.8	48.2	70.2	49.2	48.2
6 pecks	39.9	88.7	50.5	31.3	50.9	76.0	56.2	54.7
8 pecks	36.0	84.9	57.5	36.1	53.6	77.7	57.6	55.6
10 pecks	36.7	85.1	47.7	37.C	56.9	74.1	56.3	53.8
16 pecks	38.4	79.1	49.3	34.7	58.9	77.3	56.3	52.3
Last seedings Apr. 24-May 4								
4 pecks	21.8	68.2	39.5	22.2	20.4	39.7	35.3	34.3
6 pecks	23.6	72.6	45.0	28.8	18.9	48.9	39.6	38.1
8 pecks	26.9	75.6	45.1	33.4	20.0	46.7	41.3	39.3
10 pecks	25.5	77.7	44.6	32.2	22.4	46.0	41.4	38.9
16 pecks	27.5	75.4	41.6	31.5	21.0	46.3	40.5	36.5
Average of all seedings*								
4 pecks	25.1	74.9	47.2	24.8	36.4	55.9	44.1	43.1
6 pecks	31.8	81.7	51.0	31.1	38.6	64.9	49.9	48.4
8 pecks	31.1	81.2	52.5	34.7	40.6	64.3	50.7	48.7
10 pecks	31.1	81.3	52.5	34.5	42.3	63.6	50.9	48.4
16 pecks	32.9	79.7	51.7	34.5	42.3	63.5	50.8	46.8

*Two to five seedings each year.

Experiments with winter wheat sown at successive dates have shown heavier rates of sowing at late dates to be superior to lighter rates, but the heavier rates at the early sowing dates produced no greater yields. Apparently there was no such relation between rate and date of sowing Fulghum oats in the present test. Comparing the average yields of the first and last sowing dates in Table 3, the heavier rates seemed to have no advantage over the lighter rates in the later dates of sowing.

It is possible that the Miami variety, now also being used in the test, will respond differently from the Fulghum, but at present this variety has not been tested long enough to warrant conclusions.

POWDERED SKIMMILK AS A FEED FOR DAIRY CALVES

W. E. KRAUSS AND C. H. CRAWFORD

Whether or not heifer calves will be raised to replenish the dairy herd should depend upon the value of each individual, the available milk supply, and the value of the milk.

As a rule ordinary cows can be purchased for less than it costs to raise them. When a heifer of particularly good breeding is dropped it will often pay to raise her at any cost. Good cows are hard to buy, and there is some danger that they may be affected with tuberculosis, may carry the abortion germ, or harbor some other disease that may be transmitted to the herd.

What are the possibilities of raising calves to replenish the herd? This depends largely on the disposition that is made of the milk. If the cash product is cream, there will be plenty of skimmilk to feed the calves. But there is an increasing demand for whole milk due to increasing population, the increasing per capita consumption of milk, and to a considerable amount of milk now being converted into powder.

The dairyman, therefore, who decides to raise a few heifers is faced with the problem of feeding them economically. Whole milk is the natural and best food for young calves, but, on farms where whole milk is the product sold, a satisfactory substitute is desired to replace the whole milk as soon as possible.

FOOD REQUIREMENTS OF THE CALF

In order to utilize fully the calf's rapid-growth impulse the proper kind and amount of feed must be consumed. A brief summary of the food requirements will help in arriving at a safe, practical system of feeding.

The first requirement of any animal is energy. This requirement is easily satisfied, as almost all concentrates contain considerable energy that is readily available. Coarse, fibrous roughages are poor sources of energy and cannot be utilized by young calves.

Since the calf grows rapidly, its requirement for protein is high. Sufficient protein of such quality must be supplied that when it is digested it will yield the necessary substances to replace the calf's worn out tissues, and to build up the body, which, aside from water, is mostly protein.

Minerals are now recognized as substances of first importance in animal rations. A fast-growing young animal requires a considerable amount of calcium and phosphorus in its ration, since these are the principal elements that go into the bones. In some regions where "big neck" occurs a small amount of iodine is beneficial.

Vitamin A is essential for proper growth and good physical condition. There is probably also a requirement for vitamin D, as the crooked legs and stiff joints sometimes present in calves indicate some form of rickets.

A calf feed must be low in fiber and highly digestible. The young calf's stomach is quite different from that of the mature cow. The four compartments are not developed, therefore it is unable to handle much fiber.

Another essential is that the feed be palatable, for unless it is the calf will not eat to capacity and hence will not develop properly.

FEEDS SUITABLE FOR CALVES

Having determined the food requirements, the next step is to consider the feeds that can be used to meet these requirements during the early period of development.

Whole milk is the natural food for calves. It contains the various food nutrients in about the proper proportions and will suffice as the only source of food for a relatively long time. The fat and sugar furnish the necessary energy. The milk proteins, casein and albumin, furnish protein of good quality, that is, they yield, when split up in the process of digestion, the necessary amino acids essential for building up body protein and replacing cells broken down by the wear and tear of the body. Whole milk is a good source of the calcium and phosphorus, essential for proper bone formation. All the vitamins are present in milk, depending somewhat upon the conditions under which it was produced. Milk ordinarily will supply the calf's requirements for these substances until other feeds, particularly roughages, are fed. In addition to all these factors, whole milk is easily digested.

Skimmilk contains everything present in whole milk except the fat, hence its value as a feed for the calf approaches that of whole milk. While most of the fat-soluble vitamins are removed in skimming, there probably is a reserve supply at birth which helps tide the calf over from the time whole milk is discontinued until feeds containing vitamins A and D are given. The chemical constituents other than fat are present in slightly greater amounts in

skimmilk than in whole milk. Ordinarily, skimmilk does not produce the "bloom" or "finish" characteristic of whole-milk-fed calves.

Skimmilk powder is skimmilk in powdered form. There are two principal methods of manufacturing skimmilk powder, the roller process and the spray process. Other methods are modifications of these two. In the roller process the milk is run over hot cylinders on which it dries in a thin film. This film of dry milk is then scraped off and ground into a fine powder. In the spray process the milk is forced under pressure thru very small openings and falls in a fine spray into a heated chamber in which hot circulating air quickly carries away the moisture, leaving the milk solids as a very fine powder. Powdered skimmilk retains practically all the natural properties present in the original skimmilk. If a high-grade skimmilk is used, the resulting product, when mixed with water in the proportion of one part of powder to nine parts of water, is practically equal in feeding value to ordinary skimmilk. The chemical composition of whole milk, skimmilk, and skimmilk powder (spray) are given in Table 1.

TABLE 1.—Average Chemical Composition of Whole Milk, Skimmilk, and Skimmilk Powder (Spray)

Constituent	Whole milk	Skimmilk	Skimmilk powder	Remixed* skimmilk
	Pct.	*Pct.*	*Pct.*	*Pct.*
Water	87.10	90.50	3.00	90.30
Fat	3.90	0.10	1.20	0.12
Protein	3.40	3.57	37.70	3.77
Sugar	4.75	4.95	49.90	4.99
Ash	0.75	0.78	8.20	0.82

*Calculated.

Dried and semi-solid buttermilk are not as common as powdered skimmilk, but if made from high-grade raw materials they should give good results in accordance with their chemical composition. They are usually cheaper than powdered milk.

Calf meals, or so-called "milk substitutes," are composed chiefly of cereals and their by-products, mostly the latter. Some of the constituents are of doubtful value. Others, such as astringents and appetizers, are unessential for a normal healthy calf. Some commercial calf meals contain too much fiber. The better ones contain some form of dried milk, about 24 percent total protein, and not more than 3.5 percent fiber. These factors, as well as the cost, should be taken into consideration in purchasing calf meals.

EXPERIMENTAL WORK ON THE VALUE OF CALF FEEDS

A number of agricultural colleges and experiment stations have tested the value of skimmilk powder as a feed for calves. All have come to practically the same conclusion; namely, that when properly fed, skimmilk powder is equivalent to ordinary farm-separated skimmilk for calf-raising.

To obtain further evidence on this point a series of experiments was carried out on the Trumbull County Experiment Farm. The work was done cooperatively by the departments of Farm Management and of Dairy Husbandry. Particular attention was given in these studies to the economy of the various methods used in raising calves.

PART I

Eight Holstein heifer calves, five purebreds and three high grades, were used in this trial. There was some variation in the age of the calves, but otherwise they were quite uniform. The calves were divided into four lots of two each. Lot 1 received whole milk; Lot 2, farm-separated skimmilk; Lot 3, remixed, spray-process skimmilk powder (one pound of powder and nine parts of water); and Lot 4, remixed skimmilk, replaced as soon as possible with dry, spray-process skimmilk powder in the grain until at 60 days of age the calves were receiving all of their milk in powder form. The feeding trial lasted 150 days.

All the calves were left with their dams the first four days, after which they were fed whole milk from the experiment farm dairy until twelve days of age. During the following week a gradual change in feed was made to that of the lot in which the calf was placed.

Grain and hay were fed as soon as the calves would take them. The grain mixture consisted of ground corn 100, ground oats 100, wheat bran 100, linseed oil meal 50, salt 1¾. Each calf was given all the grain it would eat until it was consuming three pounds daily. Mixed hay was kept before them all the time.

Lot 1 was limited to 16 pounds of whole milk a day; Lot 2, to 24 pounds of skimmilk; Lot 3, to 24 pounds of remixed skimmilk; and Lot 4 to 2.4 pounds of skimmilk powder daily, this amount being mixed with 3 pounds of grain.

The calves were grouped together, but were fed as individuals. During the hot summer weather they were kept in the barns during the day and turned into an orchard pasture at night. When the pasture became short and dry, it was supplemented with green

soybeans fed in a rack. By this system of feeding no accurate check on the roughage consumed was possible, but it approached practical feeding conditions.

While no definite feeding schedule could be strictly adhered to because of individuality, the scheme in Table 2 was followed as closely as conditions warranted. It was designed so as to get the calves on full feed as early as possible.

TABLE 2.—Milk Feeding Schedule Followed in Experiments

Week	Lot 1 Whole milk	Lot 2 Skimmilk	Lot 3 Remixed skimmilk	Lot 4 Powdered skimmilk
1	First 4 days with cow; then whole milk	Same as Lot 1	Same as Lot 1	Same as Lot 1
2	Whole milk	Last of week; ½ whole ½ skim	Last of week; ½ whole ½ remixed skim	Last of week; ½ whole ½ remixed skim
3	Whole milk	¼ whole ¾ skim	¼ whole ¾ remixed skim	¼ whole ¾ remixed skim
4	Whole milk	Skimmilk	Remixed skim	Remixed skim
5	Whole milk	Skimmilk	Remixed skim	Remixed skim
6	Whole milk	Skimmilk	Remixed skim	0.6 lb. powder in grain
7	Whole milk	16 lb. skim	16 lb. remixed skim	1.2 lb. powder in grain
8	16 lb. whole milk	20 lb. skim	20 lb. remixed skim	1.8 lb. powder in grain
9	16 lb. whole milk	24 lb. skim	24 lb. remixed skim	2.4 lb. powder in grain
10	16 lb. whole milk	24 lb. skim	24 lb. remixed skim	2.4 lb. powder in grain
11	16 lb. whole milk	24 lb. skim	24 lb. remixed skim	2.4 lb. powder in grain
12	16 lb. whole milk	24 lb. skim	24 lb. remixed skim	2.4 lb. powder in grain
4 mo.	16 lb. whole milk	24 lb. skim	24 lb. remixed skim	2.4 lb. powder in grain
5 mo.	No milk	No milk	No milk	No milk

The calves were weighed once a week for the first four weeks and every two weeks thereafter. Their height at withers was measured at birth and every four weeks thereafter. Careful records of feed consumption and labor spent were kept.

The cost of grain and milk was computed each month on the basis of the prevailing prices. This method takes into consideration the natural fluctuation in prices. From the data given in the table the total cost of raising calves can be computed under any price conditions.

Table 3 shows that the calves in each of the four groups in Experiment 1 made satisfactory gains in weight and skeletal growth, the average of each group being above the normal average as calculated by Eckels of the University of Missouri, and used generally as a standard. It is interesting to note that the calves receiving remixed skimmilk made the most rapid gains, and that

the rate of gain of the group receiving farm-separated skimmilk equalled the rate of gain of those in the whole-milk group. All lots received approximately the same amount of feed on a dry-matter basis. However, the cost of feed varied considerably, ranging from $48.00 for the whole-milk group to $26.93 for the skimmilk group. The cost of raising the calves on remixed skimmilk and skimmilk powder was practically the same, $34.35 and $34.71, respectively.

TABLE 3.—Rate of Gain, Skeletal Development, Feed Consumption and Cost of Raising Holstein Heifer Calves on Whole Milk, Skimmilk, Remixed Skimmilk, and Skimmilk Powder

Items	Lot 1 Whole milk	Lot 2 Skim-milk	Lot 3 Remixed skimmilk spray	Lot 4 Skimmilk powder spray	Lot 5 Remixed skimmilk roller	Lot 6‡ Skimmilk powder roller	Normal (Eckles)
Birth weight, lb	99	92	89	97	90	90	90
Final weight, 5 mo., lb	346	338	368	325	304	314	302
Av. daily gain, lb	1.65	1.64	1.86	1.52	1.43	1.49	1.41
Height at withers, in	40.75	39.00	39.75	38.87	38.25	37.75	37.99
Whole milk fed, lb	2022	182	133	130	132	179	....
Skimmilk fed, lb	....	2427	....	....	.. ..	....	....
Remixed skimmilk fed, lb	....	....	2554	482	2770	640	....
Powdered skimmilk fed, lb	....	....	....	218.3	....	166	....
Grain fed, lb	257	302	275	250	140	225	....
*Cost of feed, dol	48.00	26.93	34.35	34.71	27.71	25.41	....
Feed cost per lb. gain, dol	0.194	0.103	0.124	0.152	0.129	0.113	....
Cost of labor†, dol	3.75	11.10	9.00	4.20	9.00	4.20	....
Cost of feed and labor, dol	51.75	38.03	43.35	38.91	36.71	29.61	....

*Cost of roughage not included. †Labor charged at 30 cents an hour.
‡One calf in this group was decidedly abnormal, developing a condition comparable to rickets in other animals. Data on her are not included in this table.

In addition to the cost of feed, labor is an important item. It required 37 hours to feed the skimmilk calves. Most of this time was spent in separating the milk and cleaning the separator. However, when cream is the cash product this item would be necessary anyway. The calves fed remixed skimmilk required 30 hours labor, spent chiefly in heating water and in mixing the powder with the water. Lot 1, on whole milk, required 12.5 hours for actual feeding, and Lot 4, on skimmilk powder, 14 hours.

When mixed with the grain the dry milk was very convenient to feed. There were no buckets to wash and it took but little time to mix the feed and weigh it out to the calves. Ordinarily the skimmilk powder and the grain were mixed in sufficient quantities to last about a week. In order to see if there would be any deterioration when the mixture was allowed to stand for a longer

time, a quantity of the feed was let stand for two months during the hot weather of summer with no noticeable bad effects.

In addition to the comparisons revealed by weights and measurements, several hundred people were asked to pass judgment on the condition of the calves in Lots 1, 2, 3, and 4 and to select the best group. Apparently all the calves were in equal condition, as individuals were selected from each group (Fig. 1).

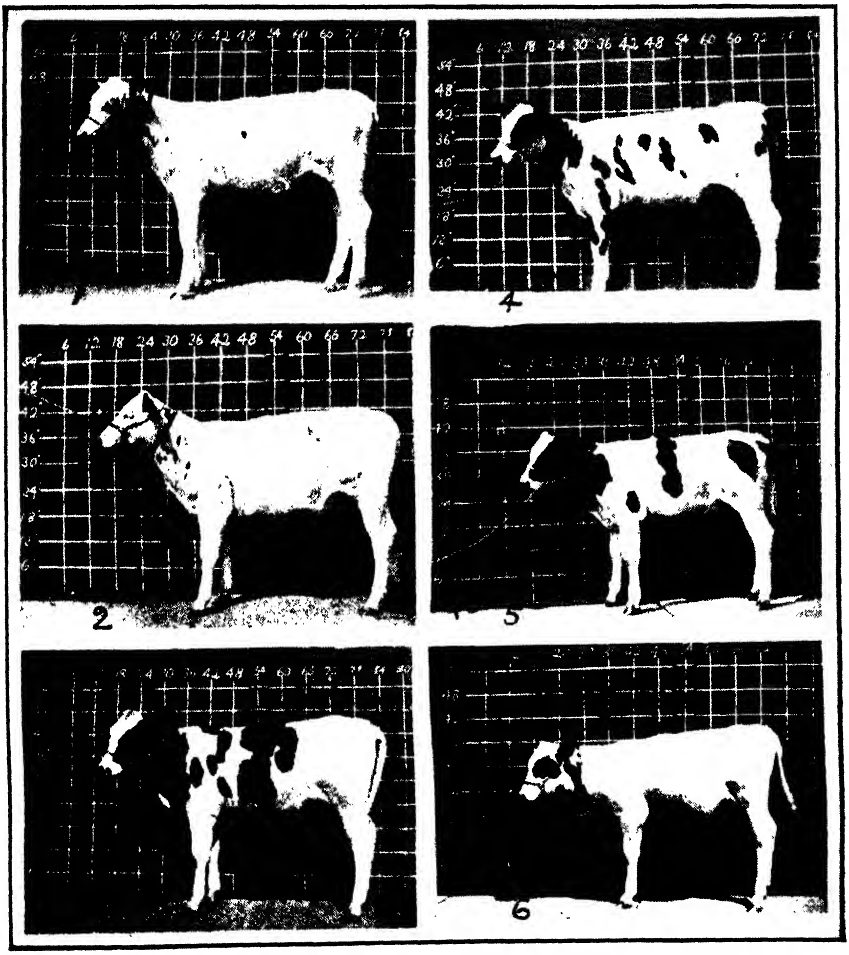


Fig. 1.—Representative calves from the six experimental lots

1. Fed whole milk. 2. Skimmilk. 3. Remixed skimmilk, "spray process". 4. Powdered skimmilk, "spray process". 5. Remixed skimmilk, "roller process". 6. Powdered skimmilk, "roller process".

Pictures of 1, 2, 3, and 4 taken at 6 months, and 5 and 6 at 5 months of age

PART II

The second experiment, Lots 5 and 6, was designated to test the value of "roller process" skimmilk powder as a feed for calves. Each lot contained one purebred and one grade calf. Lot 5 received remixed "roller process" skimmilk and Lot 6 "roller process" skimmilk powder with grain. These lots were comparable to Lots 3 and 4, respectively, in Part I.

The "roller process" powder was obtained from one source and therefore the data are not to be interpreted in terms of "roller process" powders generally. Since the conclusion of this experiment, calves at the Trumbull Experiment Farm have been getting "roller process" powder from other sources. The results are entirely satisfactory. The Massachusetts Experiment Station obtained better results with "roller process" powder than with "spray process" powder.

All the calves in this experiment gained well while receiving whole milk, but when whole milk was replaced by remixed skimmilk they showed symptoms of indigestion. Their feces were thin and often foamy and light-colored in appearance, indicating that the milk was not being properly digested. This may have been due to an unfavorable physical condition of the remixed milk, as a complete qualitative analysis of both spray and roller milk revealed no chemical difference. After the calves in Lot 6 received all of their milk mixed dry with the grain, their feces were not so soft, but their coats were rough. The lower cost of Lots 5 and 6 (Table 3) was due mostly to the lower cost of "roller process" powder. Because of the digestive trouble experienced, the consumption of grain was reduced.

CONCLUSIONS

1. "Spray process" and "roller process" skimmilk are satisfactory feeds for Holstein calves.
2. Skimmilk powder is a cheaper feed than whole milk.
3. The dairyman who sells whole milk can afford to purchase skimmilk powder with which to raise calves from his best cows.
4. The dairyman who sells cream does not need to buy milk for his calves, because his own farm-separated skimmilk makes a very satisfactory feed.
5. Of the four systems of raising calves, the one most suitable for the individual dairyman will depend upon the disposition of the milk, the price of feed in relation to the gain made from the feed, and the labor required.

THE EFFECT OF THE COW'S RATION ON THE VITAMIN-D CONTENT OF MILK

W. E. KRAUSS

As a further step in the study of the effect of the cow's ration on the food value of milk, the vitamin-D, or antirachitic potency, of milk from cows on the high-and-low-protein experiment, was determined.

The standard preventive method of determining vitamin D was employed. White rats were used as experimental animals, and the potency of both the milk and the butterfat produced by each group of cows was determined. Vitamin D is associated with ash deposition in the bones; therefore, in the following tables in which the results are shown, the greater the percentage of ash in the bones, the greater the vitamin-D content of the milk or butterfat.

To obtain further evidence as to the potency of the butterfat in the antirachitic factor, rats were fed the same basal ration as in

TABLE 1.—The Relative Vitamin-D Content of Milk From High-Protein, Low-Protein, and Normally Fed Cows as Indicated by the Percentage of Ash in Rat Bones

Group	Rats	Ash in femurs	Initial weight	Final weight
	No.	*Pct.*	*Gm.*	*Gm.*
Check, killed at beginning	5	46.28	50	....
Basal ration only	2	33.05	50	57
Basal ration plus 10 cc. milk from high protein cows	4	41.63	45	84
Basal ration plus 10 cc. milk from low protein cows	4	45.89	48	93
Basal ration plus 10 cc. milk from normal cows	4	44.24	47	82

TABLE 2.—The Relative Vitamin-D Content of Butterfat From High-Protein, Low-Protein, and Normally Fed Cows, as Indicated by the Percentage of Ash in Rat Bones

Group	Rats	Ash in femurs	Initial weight	Final weight
	No.	*Pct.*	*Grams*	*Grams*
Check, killed at beginning of experiment	4	43.65	49	....
Basal ration only	5	27.61	48	79
Basal ration plus 0.4 g. high-protein fat	4	41.16	48	78
Basal ration plus 0.8 g. high-protein fat	4	47.23	46	74
Basal ration plus 0.4 g. low-protein fat	5	44.10	48	80
Basal ration plus 0.8 g. low-protein fat	4	48.50	48	76
Basal ration plus 0.4 g. normal fat	4	38.94	48	80
Basal ration plus 0.8 g. normal fat	4	42.59	48	86
Basal ration plus 0.2 g. cod-liver oil	5	48.42	50	84

the previous trials for 24 days so that quite severe rickets developed. At this point different amounts of butterfat from each group of cows were added for 10 days. The rats were then killed and their leg bones and wrist bones removed for examination. Ash determinations were made on the femurs as before. The wrist bones were split in half with a razor, dropped into a weak solution of silver nitrate and exposed to a bright light for a few minutes. Wherever calcium had been deposited in the growing portion of the bone, which had been pretty well depleted of calcium during the development of rickets, a black area appeared.

The deposition of calcium in a healing rachitic bone starts at both sides of the growing region and works towards the middle forming a thin line. As healing progresses this calcified area

TABLE 3.—The Relative Vitamin-D Content of Butterfat From High-Protein, Low-Protein, and Normally Fed Cows, as indicated by the "Line Test"

Supplement to rickets-producing ration	Rat No.	Weight	Average daily food consumption	Calcium* deposition
		Gm.	Gm.	
Butterfat from high-protein cows, 0.4 gram...	635	57—70	6.5	—
	645	61—70	7.7	—
	652	75—88	9.0	—
	684	65—80	11.3	—
	693	64—74	7.6	—
Butterfat from high-protein cows, 0.8 gram...	640	65—79	12.0	+ +
	648	70—84	9.0	+
	655	60—77	7.6	+
	692	69—80	9.1	+
	697	80—88	8.5	+
Butterfat from low-protein cows, 0.4 gram	636	73—90	9.7	—
	646	64—74	10.1	+
	653	62—76	7.7	+
	685	62—77	10.9	+
	694	70—79	8.5	—
Butterfat from low-protein cows, 0.8 gram	641	66—73	7.5	+ +
	649	65—73	7.8	+ +
	656	60—74	11.5	+ + +
	683	66—86	12.5	+ + +
	689	65—80	11.3	+ +
Butterfat from normal cows, 0.4 gram	637	64—78	9.4	—
	647	65—75	9.0	—
	654	66—71	7.4	—
	686	62—82	9.9	—
	696	62—72	7.4	—
Butterfat from normal cows, 0.8 gram.........	642	70—76	6.0	—
	650	64—71	7.0	+
	657	57—72	9.0	+
	690	70—86	9.0	+
None...	638	67—80	9.5	—
	643	73—78	7.5	—
	651	70—76	8.0	—
	688	64—70	10.0	—
	691	69—68	7.5	—
0.2 gram cod-liver oil........................	639	68—76	8.9	+ + +
	644	78—82	9.2	+ + +
	687	52—63	8.5	+ + +

*No calcium deposition (—); calcium deposition begun (+); moderate calcium deposition (++); advanced calcium deposition (+++); complete calcium deposition (++++).

becomes thicker. Because of the characteristic line of calcium deposition, this is called the "line test", and was first used by Dr. McCollum of Johns Hopkins University. To get accurate results the bones are viewed thru a binocular microscope. The extent to which the line of calcification has progressed is designated by a plus or minus sign. The results of the "line test" are given in Table 3.

Tables 1, 2, and 3 show that milk and butterfat from the low-protein cows contained more of the antirachitic factor than did those of either the high-protein or normal cows. Inasmuch as the Vitamin-D content of feeds used in grain mixtures is negligible, and since all the cows in this experiment received silage, the difference in the vitamin content of the milk was probably due to the kind of hays used. The high-protein and normal cows received alfalfa hay; the low-protein cows received timothy hay. One other point of difference that may be of significance was that the low-protein cows received 1.5 pounds of molasses daily.

The tables show also that, while both 0.4 gram and 0.8 gram of butterfat kept the ash content of the bones above that of the bones of rats on the basal ration only, it required 0.8 gram of fat to bring about definite healing, except in the case of fat from the low-protein cows, where, in three cases out of five, healing had begun on a daily intake of 0.4 gram.

While it appears that 0.8 gram of fat from the low-protein cows was equal in vitamin-D potency to 0.2 gram of cod-liver oil, it must be pointed out that the cod-liver oil used had been standing in a cooler at about 40° F. for more than a year. Even on this basis an infant would need to drink 2 quarts of 4 percent milk a day to obtain the amount of vitamin D in the recommended dose of cod-liver oil of the potency used here.

CONCLUSIONS

Milk from cows fed a low protein ration that contained timothy hay was slightly more potent in vitamin D than milk from cows fed a high protein ration containing alfalfa hay. Whether this difference was due to the kind of roughage, the manner in which it was handled and cured, to the stage of maturity at which it was cut, or to the presence of molasses in the low-protein ration, remains to be determined.

The results obtained also indicate that cow's milk is a relatively poor source of the antirachitic factor, at least 23 cc. of milk (0.8 gram of butterfat) being required to allow practically normal bone formation in rats fed a rickets-producing basal ration.

RANGE SHELTER AND ADAPTABLE POULTRY HOUSE

D. C. KENNARD

The summer range period for pullets should be the easiest and safest in poultry management, but often it proves the most hazardous, and frequently the principal cause is found in not having the necessary range equipment. Inadequate equipment is a frequent handicap, but more serious than this is the lack of range equipment that can be easily moved from place to place so that the birds can be promptly changed to fresh soil.

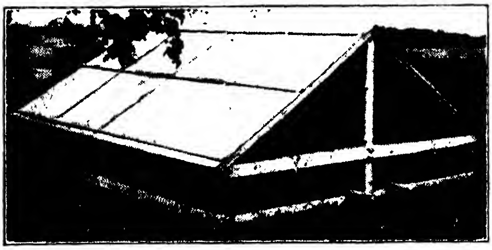


Fig. 1.—Summer range shelter

The summer range shelter (Fig. 1) can be carried to a new location by two men, or it can easily be put on a sled or wagon and taken to a distant range, where the pullets can be ranged on soil free from disease and parasites. The 10 by 12 ft. shelter will accommodate 100 to 125 pullets. The material cost is about twenty dollars. Plans and bill of material will be found in Special Circular 14.

New Adaptable Poultry House.—Description, detail plans, and bill of material are given in Special Circular No. 14, which will be mailed free upon request, addressed to the Experiment Station, Wooster, Ohio

RECEIPTS OF PRODUCE ON THE COLUMBUS WHOLESALE CURB MARKET

CHAS. W. HAUCK

Receipts on the farmers' wholesale curb market in Columbus during the last six months of 1928 aggregated 7,155 truckloads. More than 4,000 of these loads, or 58 percent, originated in Franklin County. Most of the remainder came from Pickaway, Lawrence, Fairfield, and Madison counties.

During this period 44 Ohio counties were represented on this market, furnishing amounts of produce ranging from one truckload up to 4,192. The largest amount from any county in a single month came from Franklin in August, when 1,436 truckloads from this area were offered on the market. Less than one-half of 1 percent of the truckloads originated in adjoining states.

August was the month of heaviest receipts, with 2,227 truckloads appearing on the market during that month. There was a slight decline in September, then receipts steadily dwindled to a low point of 226 truckloads in December.

A further analysis of the data is being made to disclose the source of these receipts by commodities.

TABLE 1.—Truckloads of Produce Offered on Columbus Wholesale Curb Market, July to December, Inclusive, 1928

Source of trucks (Counties)	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Pct. of total
Franklin	312	1436	1097	792	403	152	4192	58.6
Pickaway	94	306	300	96	25	14	835	11.7
Lawrence	26	65	79	125	48	14	357	5.0
Fairfield	14	78	77	75	43	15	302	4.2
Madison	19	87	117	29	19	2	273	3.8
Ross	31	48	51	62	14	......	206	2.9
Meigs	32	51	45	22	15	......	165	2.3
Delaware	9	35	60	20	8	3	135	1.9
Huron	4	37	37	45	5	......	128	1.8
Licking	15	20	44	20	10	4	113	1.6
Sandusky	......	......	18	35	5	2	60	.9
Gallia	11	14	7	11	7	......	50	.7
Lucas	......	12	3	25	7	1	48	.7
Ottawa	......	3	11	27	2	......	43	.6
Knox	......	3	10	8	6	6	33	.5
Scioto	22	3	1	2	3	1	32	.5
Morrow	12	12	......	2	......	......	26	.3
Hardin	......	......	......	11	6	6	23	.3
Wood	......	8	9	......	3	......	20	.2
Pike	......	4	6	8	1	......	19	.2
Vinton	2	......	3	5	1	......	11	.1
Erie	1	......	3	6	1	......	11	.1
Others in Ohio	4	4	19	8	3	6	44	.7
Outside Ohio	3	1	10	9	6	......	29	.4
Total	611	2227	2007	1443	641	226	7155	100
Percent	8.5	31.1	28.0	20.2	9.0	3.2	100	......

COMPARATIVE PRICES OF OHIO FARM PRODUCTS

J. I. FALCONER

It is of interest to compare the prices of the different Ohio farm products with each other and with the level prevailing in previous years. As indicated by the table below the price level of all Ohio farm products during the four years 1925-1928, inclusive, averaged 153, that is, the price level was 53 percent above the average of the five years, 1910-1914. The various commodities in the table have been arranged according to their relative price level during the last four years. Lambs averaged twice the 1910-1914 price and are, therefore, first in the table, while horses brought only 64 percent of the 1910-1914 price and occupy the lowest price position. Lambs, potatoes, chickens, wool, and dairy products have held the most favorable price position. Horses, hay, and oats have brought the lowest relative prices. The decline in number of horses has been at least a partial cause of low prices of hay and oats.

TABLE 1.—Relative Price of Ohio Farm Products

Item	Units	Average price				Index of prices 1910-14=100		
		1910 14	1921-24	1925-28	1928	1921-24	1925-28	1928
		Dol.	Dol.	Dol.	Dol.	Pct.	Pct.	Pct.
Lambs	Cwt.	6.05	10.07	12.20	12.17	166.4	201.6	201.1
Potatoes	Bu.	.77	1.20	1.52	1.09	156.5	197.6	141.7
Chickens	Lb.	.12	.20	.22	.226	174.6	190.9	193.4
Wool	Lb.	.22	.37	.41	.42	170.7	186 3	190.4
Butter	Lb.	.25	.40	.44	.47	157.7	175.6	186.0
Milk*	Cwt.	1.55	2.47	2.61	2.65	159.3	168.3	171.0
Sheep	Cwt.	4.10	5.17	6.51	6.80	126.2	158.9	166.0
Wheat	Bu.	.96	1.187	1.45	1.433	123.6	151.0	149.2
Milk cows	Head	52.67	59.85	78.20	98.00	113.6	148.4	186.0
Eggs	Doz.	.22	.32	.33	.327	143.7	148.2	145.9
Hogs	Cwt.	7.62	8.25	10.94	9.35	108.2	143.5	122.7
Corn	Bu.	.62	.73	.86	.95	117.9	139.3	153.9
Beef cows	Cwt.	6.02	6.60	8.27	10.23	109.6	137.3	169.9
Oats	Bu.	.402	.429	.45	.508	106.7	112.1	126.3
Hay	Ton	14.20	13.20	11.90	9.90	93.0	83.8	69.7
Horses	Head	163.6	105.20	105.10	116.00	64.3	64.2	70.9
All Ohio farm products						131.5	153.0	154.0

*Straight average of Cleveland, Columbus, and Pittsburgh milk.

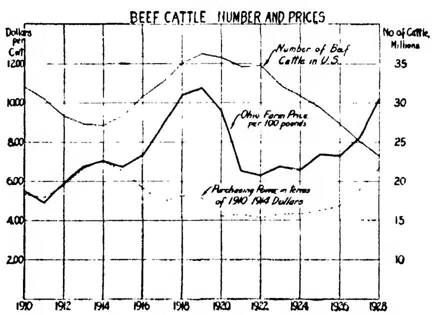
While Ohio farm prices as a whole were nearly the same in 1928 as for the last four years, several products have shown improvement. Outstanding in this respect are beef cattle prices which now, after several years of depression, have reached war-time level. The same is true of dairy cows, and dairy products have shown price improvement. On the other hand potato prices suffered a severe drop in 1928, and hog prices have been low. Corn,

altho a larger crop in 1928, brought higher prices than in 1927, but wheat, which was only 30 percent of an average crop sold for a price a little less than the four-year average. The total income to Ohio agriculture was about 4 percent less in 1928 than in 1927.

BEEF CATTLE PRICES IN OHIO

J. I. FALCONER

During the year 1928 the average price received by the Ohio farmer for native beef cattle was $10.20 per cwt.; during the year 1919, the peak of war time prices, it was $10.75. In December the average price was $10.10, a higher price than that prevailing in any December for the last 20 years with the single exception of 1918 when it was $10.20. In the accompanying chart for the years since 1910 are shown the Ohio farm price for beef cattle, the number of beef cattle in the United States, and their purchasing power. The purchasing power figure is arrived at by dividing the actual price by a figure representing the general price level. It represents, therefore, the price of beef cattle as compared to prices in general. The beef cattle prices used are those reported monthly by Ohio crop and livestock reporters and therefore represent the average quality of beef animals as kept on Ohio farms rather than that of cattle brought into the State to be fed.



Beef cattle prices in the past have moved in cycles. They were high compared with other commodities in 1885 and again in 1899 and in 1914. Low points were in 1891, 1906, and 1922. From one high point in 1885 to the second in 1899 was 14 years, from the second in 1899 to the third in 1914 was 15 years; from the low point in 1891 to the high point in 1899 was 8 years, and from the low point of 1906 to the high point of 1914 was also eight years. This year it will be fifteen years from the last high point in 1914 and in 1930 it will be eight years from the last low point in 1922. There is, however, no assurance that the length of the present price cycle will be the same as those of the past. It is also apparent that the relative price of beef cattle since 1914 has varied inversely with the number.

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

It is of interest to note that, while the prices received for Ohio farm products were better in 1928 than in 1927, the total income from sales was less. This was largely due to the failure of the wheat crop, which greatly curtailed the volume of wheat sales. For the year the income from grain sales was nearly 40 percent less than that of 1927. The sale of hogs, cattle, and sheep brought in 2 percent more, dairy products 7 percent more, poultry and eggs 4 percent more, and tobacco and wool 11 percent more than last year. As a whole the income from sales was 4 percent less than in 1927.

Trend of Prices and Wages, 1910-1914=100

	Wholesale prices all commodities U. S.	Weekly earnings N. Y. state factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm products prices	Ohio cash income from sales*
1913	102	....	100	100	104	100	104	....
1914	100	100	101	102	102	102	105	....
1915	103	101	106	100	103	107	106	....
1916	130	114	123	117	113	113	121	....
1917	181	129	150	176	140	119	182	....
1918	198	160	178	200	175	131	203	....
1919	210	185	205	209	204	135	218	....
1920	230	122	206	205	236	159	212	154
1921	150	203	156	116	164	134	132	90
1922	152	197	152	124	145	124	127	88
1923	156	214	153	135	166	122	134	95
1924	152	218	154	134	165	118	133	95
1925	161	223	159	146	165	110	159	98
1926	154	229	156	136	170	105	155	108
1927	149	231	154	131	173	99	147	94
1928	....	....	....	....	169	96	154	90
1927								
January	150	232	....	126	172	....	145	102
March	148	234	154	126	....	99	144	93
July	147	228	....	130	174	....	147	103
August	149	231	....	132	....	....	149	99
September	152	233	154	140	....	....	149	83
October	152	231	....	139	175	....	150	88
November	152	226	....	137	....	....	149	88
December	152	233	153	137	....	....	145	90
1928								
January	151	230	....	137	158	....	141	96
February	151	230	....	135	....	....	141	87
March	150	233	155	137	....	....	146	87
April	152	227	....	140	172	96	152	85
May	154	230	....	148	....	....	167	98
June	153	232	157	145	....	....	164	105
July	154	230	....	145	173	....	163	92
August	155	231	....	139	....	....	158	87
September	157	234	157	141	....	....	159	83
October	153	235	....	137	174	....	155	96
November	151	234	....	134	....	....	149	97
December	....	....	....	....	....	....	149	89

*Average month 1924, 1925, and 1926=100.

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Ohio Agricultural Experiment Station

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OHIO AGRICULTURAL EXPERIMENT STATION
Wooster, Ohio, U. S. A.

Scenes in Bryan State Park, Yellow Springs, Ohio

EFFECT OF SOIL TREATMENT AT GERMANTOWN*

C. E. THORNE

I. THE TOBACCO ROTATION

In the 3-year rotation of tobacco, wheat, and clover, begun at Germantown in 1903, all the treatment is applied while preparing the land for tobacco. The wheat and clover follow without any further treatment.

The standard dose of superphosphate has been 480 pounds per acre. For 12 years the 14-percent grade was used, after which it was changed to 16 percent. The superphosphate when used alone, increased the yields by 296 pounds of tobacco, 8½ bushels of wheat, and 1,640 pounds of hay during the first 12 years of the test, and by 107 pounds of tobacco, 12½ bushels of wheat, and 770 pounds of hay during the next 12 years. If we value cured tobacco, ready for handling, at 5 cents a pound, wheat at $1.25 a bushel, and hay at $12.00 a ton, and then throw in the wheat straw for good measure, this increase would have had an average annual value during the first period of $10.76, or $6.70 per hundred pounds of phosphate, and during the second period of $8.57, or $5.35 per hundred pounds of phosphate. Computing the superphosphate at $22.00 per ton, the annual cost of the fertilizer would be $1.76 per acre and the net gain $9.00 per acre during the first period and $6.80 during the second.

With 180 pounds of muriate of potash added to the superphosphate the yields for the combined phosphate and potash salt were increased by 619 pounds of tobacco, 11⅓ bushels of wheat and 1,625 pounds of hay during the first period, and by 511 pounds of tobacco, 16½ bushels of wheat, and 1,177 pounds of hay during the second. The annual value of these increases was $18.28 and $17.77.

Computing the cost of muriate of potash at $50.00 a ton, or 2½ cents a pound, the potash added $1.50 to the annual cost of the fertilizer, raising its total cost to $3.26, and leaving a net balance of $15.00 for the first period and $14.50 for the second, as against the $9.00 and $6.80 for the superphosphate used alone.

The potash salt has not been used alone in these tests, because the experiments at Wooster and elsewhere had shown that for practically all Ohio soils the treatment first required is phosphate, and

*Henry M. Wachter has had personal supervision of these experiments thruout the entire quarter century.

that no other treatment will produce its full effect unless phosphate also is used. For example, in the 35-year test at Wooster, superphosphate used alone increased the annual value of the crops by $4.95; muriate of potash used alone, by $2.85; and the two combined, by $9.32, or considerably more than the sum of the separate increases.

Nitrate of soda added, in Plot 8, to the combination of phosphate and potash as in Plot 3 in the tobacco rotation, increased the annual cost of the fertilizer to $6.06 an acre. The annual increases averaged $20.30 for the first period and $18.00 for the second, a net gain over cost of fertilizer of $14.24 and $12.00 for the two periods, respectively, as against $15.00 and $14.50 for the phosphate and potash for the same periods without the nitrate. While the nitrate increased the yield, the increase on this land, on which clover is grown every third season, cost too much at present relative prices of crops and nitrogenous fertilizers. But the cost of nitrogen in nitrate of soda is usually considerably less than its cost in mixed fertilizers, while nitrate of soda is the most effective carrier of fertilizer nitrogen we have.

On Plot 13 in this test the superphosphate has been 720 pounds per rotation, the muriate of potash and nitrate of soda being the same as in Plot 8, above. The outcome was a net gain over cost of fertilizer of $16.50 for the first period and $15.00 for the second, a little more than the gains for the phosphate and potash without the nitrogen. This outcome, however, indicates that if the same quantity of phosphate, 720 pounds, had been used with the potash salt without any nitrogen there would have been an equal increase, hence we have no evidence that nitrogen can be added with profit.

Neither increasing nor diminishing the quantity of potash in the fertilizer materially affected the net balance, hence the general outcome points to a combination of about 4 parts 16-percent superphosphate with 1 part muriate of potash, making a fertilizer having the formula 0-13-10, as being likely to be the most effective for such rotations as this; the quantity to be 300 pounds or more per acre for each crop grown. In this case it has all, 900 pounds, been applied to the tobacco. It must not be forgotten, however, that nitrogen is as important as either phosphorus or potash, and that unless we get the nitrogen from clover or manure we must buy it or lose out in crop yields.

This point is brought out in the tobacco grown continuously on this farm. Unfortunately, no land in this test has been treated with phosphate and potash, without nitrogen. The yield on the

land that has had no fertilizer or manure of any kind averaged 324 pounds per acre for 24 years. Where 160 pounds of superphosphate, 60 pounds of muriate of potash, and 80 pounds of nitrate of soda were applied every year the yield was increased by 337 pounds. The cost of the treatment was $6.00. Where the nitrate was doubled and the phosphate and potash remained unchanged, there was an additional increase of 75 pounds of tobacco, produced at a cost of 80 pounds of nitrate of soda. Computing tobacco at 5 cents a pound and nitrate of soda at 3½ cents there was a little profit.

Doubling the nitrate again, by adding 160 pounds, without changing the phosphate and potash, added 124 pounds of tobacco, still worth a little more than the cost of the nitrate. Another raise in the nitrate added nothing to the increase. The nitrate remaining at 320 pounds and the superphosphate increased to 320 pounds added 129 pounds of tobacco, which at 5 cents a pound paid well for 160 pounds of phosphate at a little more than one cent a pound.

Adding 60 pounds more muriate of potash to this treatment added 55 pounds to the yield, which gave a good profit for 60 pounds of muriate at 2½ cents a pound.

This outcome shows that we must drive a 3-horse team—phosphorus, potash, and nitrogen—if we are to raise tobacco without the help of clover, and we must so hitch them that each will pull his full share of the load. The combination that has done the most effective work in this case has been the equivalent of a 10-10-12 fertilizer. It is probable that a further increase of the phosphate would increase the effectiveness.

Where lime was added to the standard fertilizer treatment in the rotative cropping, using 1,000 pounds of quicklime or hydrated lime at first and 1,000 pounds of ground limestone later, the yields of tobacco were reduced, as compared with the standard treatment. The yields of wheat remained stationary, and those of clover were increased, especially during the second period. The average annual value of all the crops, as here computed, was increased by one-half dollar during the first period, not enough to pay for the lime. This outcome is very different from that which is found in eastern Ohio and suggests that, while an occasional liming may pay in the increased thrift of the clover, the Miami Valley farmer should not be encouraged to undertake a systematic use of lime such as is necessary in eastern Ohio. But if nitrogen is not to be bought, or found in the careful conservation and use of manure, it is of the utmost importance that the yield of clover be maintained, and an occasional liming for this purpose is likely to be justified.

Several plots in this test have been treated with manure. The outcome as compared with the fertilizer treatment on Plot 13 is shown in Table 1. The increase is given in the total value for the three crops of the rotation.

TABLE 1.—Value of Increases in Yields of Tobacco, Wheat, and Clover

Treatment per acre per rotation of three years	Value of increase per rotation	
	First period	Second period
	Dol.	*Dol.*
Chemical fertilizers	70.40	67.20
Shed manure untreated, 10 tons	48.20	46.50
Shed manure untreated, 20 tons	65.00	61.00
Shed manure phosphated, 10 tons	59.60	70.00
Yard manure phosphated, 10 tons	48.20	52.15
Shed manure untreated, 10 tons, and lime	51.00	56.15
Yard manure untreated, 10 tons, and lime	37.40	41.55

The cost of the chemical fertilizer for the 3-year period would be about $21.00 at the prices here assumed. The 10 tons of untreated shed manure would have had to cost nothing to have given as large a net return as the chemicals in either period, and the 20 tons would have barely paid the cost of hauling and spreading. The 10 tons of phosphated shed manure would have earned about 50 cents a ton during the first period and nearly $2.00 a ton during the second, over the cost of the phosphate used in treating it. The liming has diminished the effect of the manure, the reduction being greater during the first period than during the second. No estimate is here made of the relative labor costs of applying the fertilizer and the manure.

This low effect of manure is accounted for in the indifference of these crops, especially of tobacco, to nitrogen when following clover in rotation, nitrogen being the chief constituent of manure.

Sulfate of potash as compared with muriate of potash somewhat reduced the yield of tobacco during the first period, but both carriers of potash gave practically the same increase during the second period.

Sulfate of ammonia and nitrate of soda produced practically the same yields on the unlimed land. There was a little advantage for the sulfate on the limed land.

II. THE CEREAL ROTATION

In the 3-year cereal rotation of corn, wheat, and clover, superphosphate, applied at the low rate of 120 pounds per acre each on corn and wheat, increased the yield by an average annual value of

$5.20 per acre for the first 12 years and of $6.20 for the second 12 years, if we value corn at 80 cents a bushel, wheat at $1.25 and hay at $12.00 a ton, taking no account of the stover or straw.

At $22.00 a ton the cost of the superphosphate would be about $2.70 for the 3-year period, or 90 cents a year. This would leave $4.30 and $5.30 a year as the net gain from its use, not counting labor of applying the fertilizer nor of harvesting the extra crop, which would be partially offset in the increased stover and straw.

Applications of 20 pounds of muriate of potash and 120 pounds of superphosphate increased the annual cost of the fertilizer to about $1.25. The annual yield was increased by $7.47 for the first period and $9.58 for the second, a net gain of $6.22 for the first period and of $8.33 for the second. The addition of potash on this land was profitable. Figured in percentages, this fertilizer would correspond approximately to an 0-13-7 formula.

Nitrate of soda added at the rate of 80 pounds to this mixture of superphosphate and muriate of potash raised the annual cost of the fertilizer to $3.10, if we compute the nitrate at 3½ cents a pound. The total increase in crops was raised to $8.94 per annum for the first period and to $10.41 for the second, leaving a net balance of $5.84 for the first period and of $7.31 for the second.

Altho the nitrate considerably increased the yield, its high cost reduced the net gain. At 3½ cents a pound, or $70.00 a ton, for nitrate of soda the cost of its nitrogen is about 23 cents a pound; but the nitrogen in factory-mixed fertilizers usually costs the farmer from 25 to 30 cents a pound, and is usually less effective than that in nitrate of soda.

The standard mixture of the three materials, as used in this test, would correspond to a 5-8-4 formula. When the quantity of superphosphate was doubled, raising the dressing for each grain crop to 80 pounds of nitrate of soda, 240 pounds of superphosphate, and 20 pounds of muriate of potash, corresponding to a 3½-11-3 formula, and costing $4.00 a year, the annual increase was worth $12.20 for the first period and $11.75 for the second, giving an annual net balance of $8.20 for the first period and $7.75 for the second. During the first period, therefore, this was the most profitable treatment; but during the second it was surpassed in net gain by the fertilizer carrying phosphorus and potash without any nitrogen, altho this combination did not give quite as large a total gain as the one containing nitrogen. In this work we must remember that it is not always the largest yield that leaves the most money after paying its cost.

This outcome is in line with the other experiments over the limestones of western Ohio, in Hancock, Miami, Madison, and Hamilton Counties, in which nitrogen has not paid its cost where clover was systematically grown in the rotation. The only tests west of the Scioto in which the cost of nitrogen has been recovered with profit are in Clermont and Paulding Counties, where the soils are very different from those found on the uplands of the Miami Valley. In Miami County the nitrate actually reduced the yield.

Lime used on unfertilized land at the rate of 1,000 pounds of ground limestone on every corn crop in this rotation increased the yield, but when used on fertilized land the increase did not pay its cost. On manured land we get the following results from an average dressing of 5 tons of manure per acre for each 3-year period, used with or without liming, the increase given being the total value of the 3 crops of the rotation—not the annual value as previously given.

TABLE 2.—Increases in Crop Yields From Untreated and Treated Shed Manure on Corn, Without and With Lime on Wheat

Plot	Treatment	Value of increase	
		First period	Second period
		Dol.	*Dol.*
24	Untreated shed manure on corn	22.20	25.38
17	Same, with lime on wheat	23.73	29.10
	Gain for 1000 lb, lime	1.53	3.72
27	Phosphated shed manure on corn	21.63	36.72
29	Same, with lime on wheat	26.28	38.28
	Gain for lime	4.65	1.56

Raw phosphate was used in treating the manure during the first period but produced very little effect, as these figures show. The phosphate was then changed to superphosphate, with a marked gain in the increase. Taking the entire 24 years, the liming did not add enough to the effect of the manure to pay its cost.

Whether to use manure and lime on corn or wheat, either separately or on the same crop, is studied in a series of plots. The results, altho somewhat in favor of liming the corn and manuring the wheat, indicate that it is not very important which method is employed. Results elsewhere indicate that lime produces a greater effect when used on corn and that manuring the wheat increases the yield of the clover following.

It seems with these crops, as with the tobacco rotation, that an occasional small dose of lime would be of advantage on this soil, but that it is not yet ready to respond to systematic liming, such as has become necessary on eastern Ohio soils.

TABLE 3.—The Effect of Phosphating the Manure, Computed for a 3-year Rotation

Plot	Treatment	Three years value of increase	
		First period	Second period
		Dol.	*Dol.*
23	Untreated yard manure	12.78	15.15
26	Phosphated yard manure	17.61	29.88
	Gain for phosphate	4.83	14.73
	Cost of phosphate	1.10	2.20
	Net gain for phosphate	3.43	12.53
24	Untreated shed manure	22.20	25.38
27	Phosphated shed manure	21.63	36.72
	Gain for phosphate	None	11.34
	Cost of phosphate	....	2.20
	Net gain for phosphate	....	9.14

The phosphate has been used at the rate of 40 pounds per ton of manure, or 200 pounds for the 5 tons of manure used during the rotation. The average gain per ton for untreated yard manure on unlimed land was $2.56 in the first period and $3.03 in the second; for untreated shed manure on the unlimed land, $4.10 for the first period and $6.90 for the second.

TABLE 4.—Treatments and Actual Yields per Acre in These Tests, Averaged for the Entire Period of 24 Years

Tobacco rotation

Crop	No treatment	Superphosphate, potash	Superphos., potash, nitrate	Shed manure 20 tons	Shed manure 10 tons phosphated
Tobacco........lb..	505	1,109	1,282	1,161	1,145
Wheat........bu..	13.18	29.17	31.87	30.54	30.72
Clover........lb..	2,181	3,796	4,107	3,731	3,903

Cereal rotation

Crop	No treatment	Superphosphate, potash	Superphos., potash, nitrate	Shed manure phosphated 5 tons	Shed manure phosphated 5 tons lime
Corn........bu..	39.64	50.18	57.66	59.55	62.23
Wheat........bu..	11.06	19.96	26.04	19.17	20.73
Clover........lb..	2,148	2,790	3,347	2,904	3,350

The yields of corn and wheat on the fertilized and manured land were larger during the second 12 years than during the first. Those of tobacco and clover were smaller. The lower average of clover in the second period was because of winter injury. If we were to count only the years when clover was harvested, there would be but little difference between the two periods.

HOW MANY CUTTINGS OF ALFALFA?

C. J. WILLARD*

Ever since alfalfa has been grown in the Corn Belt, there has been discussion as to the proper stage of maturity at which to cut it. It is not possible to separate the question of the proper stage of harvesting alfalfa from that of the number of cuttings secured. Cutting alfalfa at late stages of development will result in fewer cuttings for the season than will cutting early. Recent articles in the farm press and elsewhere have suggested very late stages of harvesting, even recommending only two cuttings in central Ohio.

Four years experiments have been completed at Columbus to determine the best stage at which to harvest alfalfa, and hence the most profitable number of cuttings.† Alfalfa has been cut five, four, three, and two times each season. The first cutting in each series has been made respectively at bud stage, very early bloom, nearly full bloom, and early seed stage. The last cutting has been made on the same date for all systems of harvesting, and the other cuttings on such dates as would divide the time approximately equally between the different cuttings. The average times between cuttings after the first were, respectively, 31, 36, 48, and 83 days for five, four, three, and two cuttings per year. The yields are reported in Table 1.

Yields were secured from small representative areas selected from the larger plot and harvested by hand, and are, therefore, higher than would have been obtained by machine harvesting. Practically all the yields reported as less than 1,000 pounds per acre were from alfalfa which was so short that a rake would have lost the greater part of it in field practice. The yields above 1,500 pounds checked very closely with field practice.

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†The detailed results on which the recommendations in this article are based will be reported in a technical publication shortly.

TABLE 1.—Yields of Alfalfa Under Different Cutting Treatments

Cutting and date	Pounds hay per acre				
	1925	1926	1927	1928	Average
Cut 5 times:					
1st—May 16-28	3320	2730			3030
2d—June 17-28	2450	1300			1880
3d—July 17-29	1770	1160			1460
4th—Aug. 19-27	1300	1880	Dead		1590
5th—Sept. 23-25	930	940			930
Winter cover*	(900)	(660)			(780)
Total hay	9770	8010			8890
Cut 4 times:					
1st—May 31-June 7	3840	3600†	2620	2310	3090
2d—July 6-13	2730	1390	1940	1590	1910
3d—Aug. 9-20	1550	2080	1140	830	1400
4th—Sept. 11-25	1280	1650	780	330	1010
Winter cover*	(1080)	(960)	(1340)	(290)	(920)
Total hay	9400	8720	6480	5060	7410
Cut 3 times:					
1st—June 13-15	3710	4020	4970	3640	4080
2d—July 26-Aug. 5	2260	1840	3200	3380	2670
3d—Sept. 11-25	1380	1940	1670	1640	1660
Winter cover*	(1310)	(1390)	(2030)	(1340)	(1520)
Total hay	7350	7800	9840	8660	8410
Cut twice:					
1st—June 26-28	3290	3480	5290	4910	4240
2d—Sept. 11-25	1280	1940	1560	1180	1490
Winter cover*	(1340)	(1160)	(1390)	(960)	(1210)
Total hay	4570	5420	6850	6090	5730

*Not removed. †Estimated from yields of May 31 and June 13.

The yields in 1926, 1927, and 1928 were from the same series, which was sown in 1925; the yields in 1925 were from plots in a field sown in 1924, but not continued after June 1926. The yields for June 1926 on these plots are given in Table 2.

TABLE 2.—Yields of Alfalfa Sown in 1924

Treatment in 1925	Pounds hay per acre June 3-7, 1926
Cut 5 times	3590
Cut 4 times	4470
Cut 3 times	4650
Cut 2 times	4300

Effect of number of cuttings on yield.—These figures show that three cuttings of alfalfa at Columbus are much preferable to two cuttings. Since most of western and southern Ohio has a growing season as long or longer than Columbus, these results should apply in all parts of the State except Northeastern Ohio. Unpublished experiments at Wooster by L. E. Thatcher indicate that two cuttings are probably preferable to three. But when three cuttings yield an average of 8,410 pounds of hay while two make only 5,730 pounds of inferior hay, as at Columbus, there is little doubt as to the superiority of three cuttings.

The case for three cuttings over four is not so clear. The first year after seeding, four cuttings made decidedly more hay, but in the 1926-27-28 series the yield in later years was much reduced because of loss of stand. However, the year 1925 was unfavorable for producing a vigorous stand, so these results are about as unfavorable to four cuttings as are likely to be secured. In favorable seasons, or to secure especially high quality hay, there may be a place for four cuttings of alfalfa in this latitude.

Five cuttings were too many. The disastrous effect of very early cutting was outstanding here as it has been in every other test which has been made. While five cuttings apparently outyielded four in 1925, in actual farm practice much of the hay would have been lost in harvesting.

Effect on winterkilling.—In 1927, the plots cut five times in 1926 were so completely winterkilled that no further harvests could be made on them. The plots cut two and three times were uninjured at this time, while the plot cut four times was slightly injured (Fig. 1).

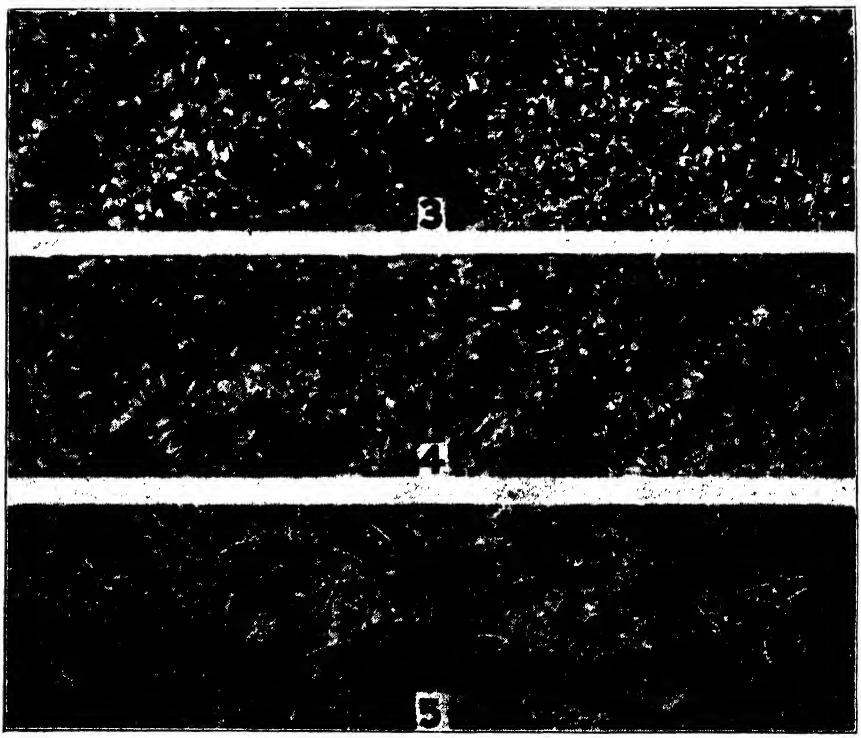

Fig. 1.—Alfalfa cut 3 times (top), 4 times (middle), and 5 times (bottom) in 1926; photographed April 30, 1927

In 1928 the plots cut four, three and two times showed, respectively, 48, 12, and 2 percent of winterkilling as determined by counts of living and dead plants (Fig. 2). Furthermore, the plot cut four times started off much more slowly than that cut three times (Fig. 3) and suffered much more from weed invasion.

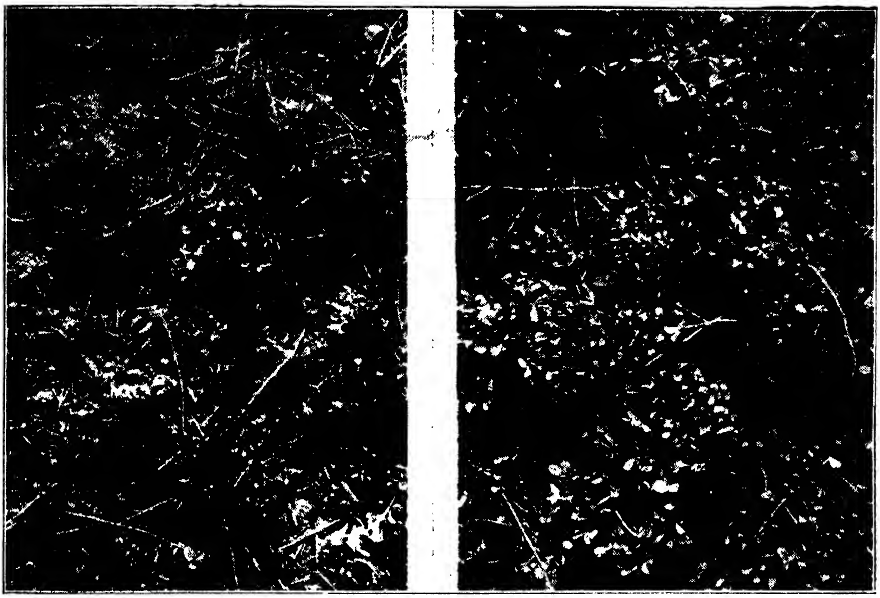

Fig. 2.—Alfalfa cut 4 times (left) and 3 times (right) in 1926 and in 1927; photographed April 17, 1928

Effect on organic reserves in the roots.—When alfalfa starts growth after cutting, or in the spring, the material for the first growth must come from reserve food materials stored in the roots. After considerable growth is made, the leaves, which are the food factories of the plant, may elaborate more organic materials than can be built up into new growth, and then the reserve materials in the roots are replenished. If the alfalfa is cut too soon, the root reserves are not replaced and gradually decrease, resulting in slow recovery after cutting and ultimately the death of the plants.

TABLE 3.—Pounds of Air Dry Roots per Acre, Early in November

Number of cuttings	1925	1926	1927	1928
Cut 5 times	1900	1250	Dead	Dead
Cut 4 times	2710	1890	2090	1240
Cut 3 times	2840	2150	2740	2820
Cut 2 times	2740	2200	2040	2170

Thruout this investigation, harvests of roots were made at each cutting and at such other times as were necessary to trace the effect of different systems of cutting on the root reserves. Table 3 gives the weight of roots per acre with which the alfalfa went into the winter, following the different cutting treatments. These harvests were made early in November of the different years.

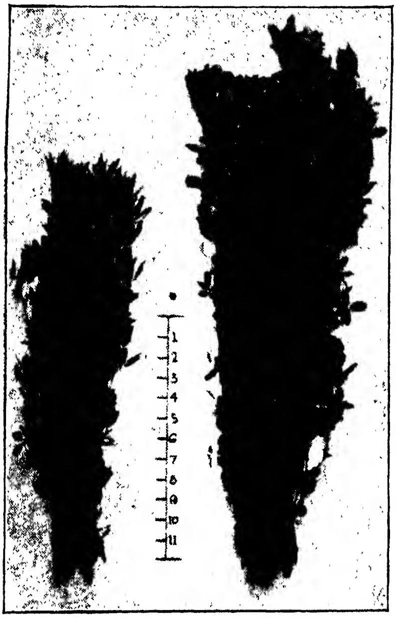

Fig. 3.—Equal areas of alfalfa cut 4 times (left) and 3 times (right) in 1926 and 1927, taken May 26, 1928.

The effect of frequent cutting in depleting root reserves is shown in the smaller weight of roots in the more frequent cuttings. The smaller amount of reserves in alfalfa cut twice than in that cut three times seems to have been due to the effect of "yellowing", but this is not certain.

Effect on quality of hay.—It is well known that early cut hay is of higher quality than late cut hay, and this is again brought out by these experiments. Two important measures of quality in alfalfa are the percentages of protein and of leaves in the hay. Table 4 gives these figures for the different cutting treatments.

TABLE 4.—Total Protein and Leaves in Alfalfa Hay per Year, 4-year Average

Number of cuttings	Protein	Leaves	Protein per acre
	Pct.	*Pct.*	*Lb.*
Cut 5 times*	20.1*	53.4*	1783*
Cut 4 times	19.2	53.2	1426
Cut 3 times	16.7	45.4	1408
Cut 2 times	15.2	38.2	873

*Two years only.

The very poor quality of the 2-cutting hay, averaging 535 pounds of protein per acre less than 3 cuttings, is especially important. Three and four cuttings seem almost equal when total protein content is considered, but under the conditions of the experiment three cuttings constitute the best practical recommendation.

These figures also have a bearing on the market value of the hay. U. S. No. 1 alfalfa must contain at least 40 percent of leaves, and U. S. Extra Leafy alfalfa at least 50 percent of leaves. On leaf content alone, the hay cut four and five times would grade Extra Leafy, as an average; that cut three times would grade No. 1, while that cut twice could not grade above No. 2. Under actual curing conditions a certain percentage of the leaves would be lost, and the color of the 3-cutting hay seldom, if ever, permits its grading No. 1.

Shoots at the crown.—The shoots at the crown were given no consideration in these experiments, but we noted their presence or absence and the effect of cutting before and after they appeared. Our observations agree with those of several others, that in the humid Corn Belt at least, there is no necessary connection between shoots at the crown and the proper time to cut alfalfa. Almost the only condition under which a large number of shoots start from the crowns at a uniform time is when a considerable drouth is broken by a soaking rain. Under this condition, if the old growth is removed just as soon as the shoots start, the new growth comes on very rapidly. Ordinarily, however, the new shoots appear most irregularly, and many factors modify their appearance. One who does not have a good idea of when he wants to cut his alfalfa will not be helped by the "new shoot" rule, because of its indefiniteness. Furthermore, if new shoots are cut off because of delaying the harvesting to a late stage, no harm is done. There are many more to take their places.

PRACTICAL RECOMMENDATIONS AND CONCLUSIONS*

1. Except in northeastern Ohio, alfalfa in Ohio should be cut at least three times during the season. Cutting twice resulted in an average loss of 2,680 pounds of hay, and the two-cutting hay contained 1.5 percent less of protein and 7.2 percent less of leaves than the three-cutting hay. The stand was maintained slightly better by three cuttings.

2. Cutting four times regularly weakened the stand severely, and is inconsistent with keeping the stand for a period of years. Exceptional years, like 1925, will sometimes permit four cuttings without injury. Where exceptionally high quality hay is desired and alfalfa stands are readily secured, it might easily be profitable to cut alfalfa four times the first year after it is sown and keep the

*These recommendations apply to the latitude of Columbus. Judging from maps of the length of the growing season, they should apply thruout the entire central third of Ohio and in most of northwestern Ohio.

stand only one or two years. During the first year of cutting, cutting four times produced 507 pounds more protein per acre than cutting three times. The growing season at Columbus is too long for three cuttings at the most favorable stage and yet not quite long enough ordinarily for four.

3. Cutting five times was disastrous to the stand, and is impractical even if the crop is to be left only one year.

4. The last cutting in the fall should be made early enough so that the alfalfa may go into the winter with a healthy vigorous growth 10 to 12 inches in height. This has always been recommended by growers of alfalfa and by writers, but the reason given has been that of furnishing a mulch for winter protection. This is certainly one factor, especially where heaving is as important a cause of winter-killing as it is on Ohio soils. But our root studies indicate that another and perhaps more important reason is that October is an important period of storage in the roots, provided there is a vigorous top growth to build up the materials. If alfalfa is cut late in September or in October, instead of building up there is a drain on the root reserves to make new growth, and the roots go into the winter in a depleted condition.

5. The first cutting should usually be made at a somewhat earlier stage than the second or third, because it usually loses in quality more rapidly than the other cuttings if cutting is delayed.

6. The best practical dates to secure three cuttings of alfalfa have been June 5-12 for the first cutting, July 20-27 for the second, and September 1-8 for the third. These arbitrary dates are nearly as satisfactory as any other method of deciding when to harvest alfalfa.

7. The shoots at the crown should be ignored as an indication of when to cut alfalfa.

8. The best indications that alfalfa is ready to cut are the slowing up or cessation of vegetative growth and the stage of bloom. The stopping of vegetative growth is usually accompanied by a slight yellowing of the field. Since leaves are constantly being lost from the older parts of the stem, as soon as vegetative growth stops, the field "goes back" in both yield and quality, and the sooner it is cut the better. This stage is usually just before full bloom, but in a wet season, may be during full bloom. In this State the bloom is so irregular and uncertain that it is difficult to convey a definite impression of when to cut by the bloom. "Full bloom" is especially indefinite, since it may last for two or three weeks. The

best stage, however, begins about five days after the first blooms appear, and continues until full bloom. When there is a large amount of alfalfa to harvest, it is especially important not to wait too late before starting the mowers. In a wet season in which the alfalfa keeps on growing rapidly, cutting may and should be delayed longer than in a dry season.

RATE AND DATE OF SOWING SOYBEANS

H. L. BORST*

An experiment on the rate and date of sowing soybeans was begun at Columbus in 1922 and continued thru 1927. Manchu and Peking varieties were used thruout the test. Manchu, which has become the most popular seed variety for Ohio, is an early bean maturing in about 135 days at Columbus. It has a medium large yellow seed with a characteristic black seed scar or hilum. Peking is a later very erect-growing variety, valuable for hay and for silage when planted with corn. It has a small black seed, and matures in about 145 days at Columbus.

The two varieties were grown in rows 28 inches apart in order to control weeds. The yields were determined from two-row plots, either 12 or 16 feet in length, grown in four replications. One row in each plot was harvested for hay and one for seed.

Three rates of planting were used; thick, plants three-fourths to one inch apart; medium, plants three and one-half inches apart; thin, plants eight inches apart. These rates were selected with the idea of using two extreme rates and an average rate.

The thick rows were not thinned. To obtain the desired spacing in the medium and thin plantings, seeds were sown at heavier rates and the seedlings thinned to the stand desired.

Except in 1923, plantings were made on April 10, April 20, and May 1, and every two weeks thereafter until the first of August, or as near as possible to these dates.

Hay yields were obtained by cutting the plants at the best hay stage, that is when the pods had formed and the beans were approximately one-fourth grown. All yields were determined on

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an air-dry basis. The yields of hay from the various dates and rates of sowing the two varieties are given in Table 1, and set forth graphically in Figure 1.

TABLE 1.—Hay Yields of Manchu and Peking Soybeans Sown at Different Rates and Dates

Air-dry weight, pounds per acre, five-year average, except where noted

Dates sown	Manchu				Peking			
	Rates sown			Av. of 3 rates	Rates sown			Av. of 3 rates
	Thick	Medium	Thin		Thick	Medium	Thin	
April 10	4227*	3942*	3386*	3852*	4244†	3737†	3723†	3901†
April 15-20	4813	4448	3902	4288	4459	4181	3938	4192
May 1	5179	4416	4027	4541	5443	5091	4823	5119
May 15	5121	4252	3706	4360	5357	4906	4444	4902
June 1	4772	4115	3865	4251	4800	4293	3938	4344
June 15	4259	3532	2843	3545	4153	3626	3333	3704
July 1‡	3464	3001	2754	3073	3669	2979	2775	3141
July 15	2347	2077	1806	2077	2801	2481	2208	2497
Aug. 1	1537	1138	821	1165	1295	853	736	961
Average of all dates	3969	3436	3012	....	4025	3572	3435	....

*Two-year average.
†Three-year average.
‡All rates four-year average from this date on.

Date of sowing results.—The largest average yields of hay from each variety was obtained from planting on May 1. The next best yields, only slightly lower, were obtained from the May 15 planting. Manchu planted on June 1 produced yields only slightly lower than those from the May 1st and May 15th plantings, when the average of the three rates is concerned, and nearly the same as the April 20th planting. Peking, however, planted on June 1 produced more than 500 pounds per acre less hay than when planted on May 15 and more than 700 pounds less than when planted on May 1, when the yields of the three rates are averaged. After June 1 the yields of both varieties show decided decreases for each sowing date.

Yields of seed of both varieties are given in Table 2 and in Figure 2. When yields of Manchu seed are considered, there is little choice between the first four dates of planting, namely, April 10, April 20, May 1, and May 15. Peking, unlike Manchu, produced the highest seed yields when sown at the earliest date. The yields of this variety showed a fairly progressive decrease when it was sown at successively later dates. It should be noted that the yields from sowing April 10 are only a two- and a three-year average, and are not strictly comparable to those of the yields of later sowing dates.

Better yields of seed were obtained from Manchu than from Peking when these varieties were sown at successively later dates after June 1. The yields of both varieties, however, decrease markedly as the sowing was delayed after this date.

TABLE 2.—Grain Yields of Manchu and Peking Soybeans* Sown at Different Rates and Dates

Bushels per acre, four-year average, except where noted

Dates sown	Manchu				Peking			
	Rates sown			Av. of 3 rates	Rates sown			Av. of 3 rates
	Thick	Medium	Thin		Thick	Medium	Thin	
April 10	34.6*	30.8*	26.4*	30.6	38.0†	33.7†	28.7†	33.4
April 15-20	36.2	32.9	28.7	32.6	32.1	32.5	29.3	31.3
May 2	33.1	32.5	25.5	30.3	27.7	29.0	28.3	28.3
May 15	33.3	30.7	26.7	30.2	32.1	29.8	24.8	28.9
June 1	30.8	30.4	27.3	29.5	25.7	25.9	23.2	24.9
June 15	28.6	28.4	24.0	27.0	23.6	21.3	19.9	21.6
July 1	28.7*	24.7*	21.2*	24.9	16.8	16.1	15.4	16.1
July 15	8.0*	8.1*	4.2*	6.7	7.6†	7.4†	5.9†	6.9
Average	29.1	27.3	23.0	....	25.4	24.5	21.9	....

*Three-year average.
†Two-year average.

Early May sowing desirable.—The foregoing data clearly indicate the desirability of timely sowing of soybeans. At Columbus sowing much after May 15 resulted in decreased yields of both hay and seed. Sowings as early as April 20 produced good yields of seed, but not of hay. Sowing much before the 1st of May at Columbus is probably inadvisable because of the impracticability of preparing a seed bed and because of the danger of frost. In 1924 only one-half a crop was obtained from the early April sowing, because of frost injury. Objection is often made to sowing as early as May 1, or even May 15, because of the difficulty at this time of working a seed bed sufficiently to kill weeds. This objection is often valid but where soybeans are sown on corn stubble, as is often done, the seed bed can be prepared by disking.

Rate of sowing.—The heaviest rate of seeding of each variety produced the largest yield of hay, see Table 1 and Figure 1.

The hay produced by the thick rate of planting had finer stems, but the percentage of leaves and stems was found to be the same from all rates and dates of planting. Feeding analyses of the hay from the various rates and dates of planting showed no difference in protein, carbohydrate, or fibre content. It was observed that the beans planted at the thickest rate grew in height more rapidly than those planted at the medium and thin rates.

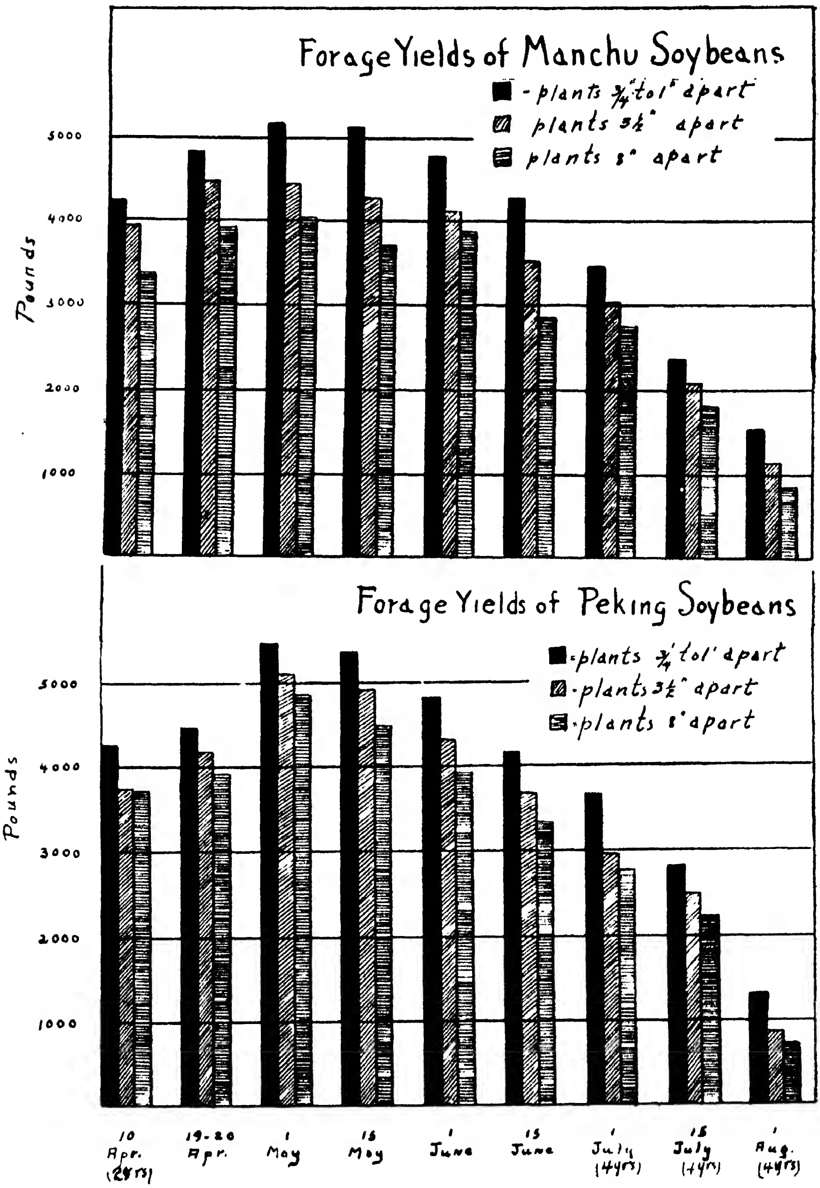

Fig. 1.—Forage yields of Manchu and Peking soybeans, seeded at three rates and on nine successive dates. Five-year average dry weight per acre, except where noted

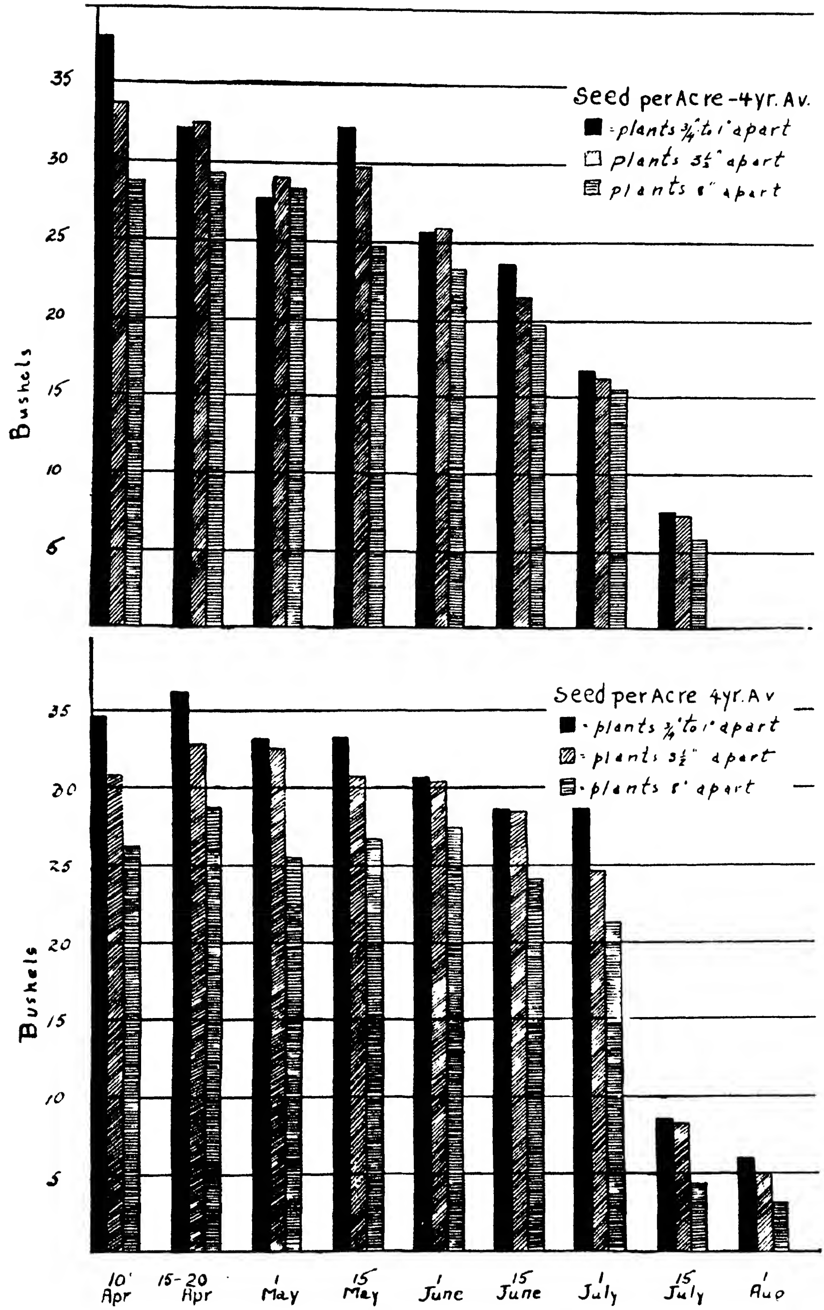

Fig. 2.—Seed yields of Peking (above) and Manchu soybeans (below), seeded at three rates and on nine successive dates. Four-year averages, except Manchu for April 10 and July 15, each two years; and Peking for April 10, July 15, and August, three years.

There was not as much difference between the medium and thick rates in the production of seed as in the production of hay, see Table 2 and Figure 2. The yields from the thick rates were variable and the differences between them and the yields from the medium rate were not consistently large. The thick rate had a slight advantage over the medium rate, while the medium rate was always superior to the thin rate.

Thick sowing most desirable for production of hay.—It is fairly clear that a rate of seeding which spaced the plants about one inch apart was profitable for the production of soybean hay. Larger yields were obtained from this spacing and the hay was of better quality. Closely spaced plants grew tall more rapidly, shaded the ground sooner and in this way gained an advantage over weeds more quickly. It may be that the thick rate used in this test is thicker than the best rate for each variety. However, in experiments at the Iowa Agricultural Experiment Station, where a large number of rates was used, the best yields of both seed and hay were obtained from one-inch spacing between plants.

Good yields of seed from thinner rate.—The thick rate of sowing did not have the advantage in seed production that it had in hay production, since the plants sown with the 3½ inch spacing produced nearly as much as those sown one inch apart. It would seem that a two-inch spacing would be an optimum rate of seed production of both of these varieties.

Recommended rates.—With the findings of the experiment in mind, the following recommendations are made:

Amounts per Acre for Rows 28 Inches Apart

	MANCHU (or similar sized seed)	PEKING (or similar sized seed)
For seed	4-5 pecks	2-3 pecks
For hay	6-8 pecks	4 pecks

For so-called "solid" sowing these rates should be increased about 20 percent.

STEER FEEDING ON PASTURE VS. FEEDING IN DRY LOT

PAUL GERLAUGH

Steers fattened on bluegrass pasture made more rapid gains, much more efficient gains, shrank more enroute to market, sold for less money on the market, dressed 1 percent less, but returned more profit than steers fattened in a dry lot, in a test conducted during the summer of 1928.

On June 5, 1928, a lot of nine Hereford steers were turned onto bluegrass pasture, and fed ground shelled corn and linseed meal. Similar steers were fed in a shed and given a ration containing ground shelled corn, linseed meal, corn silage, and mixed hay.

Both lots had been fed from December to June, a ration of corn silage, linseed meal, and alfalfa hay. They were divided into their respective summer lots on the basis of their gaining ability during the period from December to June. The average daily gain during this period was 1½ pounds.

From the start the pasture cattle made more rapid gains, tho their condition did not show it. Evidently they were growing more than the dry-lot cattle.

The cattle on pasture were much slower in taking hold of the grain ration. However, at the end of six weeks both lots were taking the same amount of ground shelled corn, and thereafter the cattle on grass consumed more corn than the dry-lot cattle. For the entire period the two lots averaged practically the same amount of corn, and the linseed meal was fed at the rate of two pounds daily per steer, thruout the test. The roughage for the dry-lot cattle was 5.6 pounds of silage and nearly 2 pounds of mixed hay, daily. Five acres of pasture supplied the grass which the nine head consumed. In spite of the abnormally dry season late in the summer there was grass available at all times.

The table shows an average daily gain of 1.88 pounds for the dry-lot cattle and 2.36 pounds for the cattle fed on pasture. This difference of nearly one-half pound daily is somewhat deceptive. The cattle in the shed showed more finish than the pasture cattle until the last three or four weeks of the test. This would indicate that the pasture cattle grew more than the dry-lot cattle. Tissues of growth contain more moisture, hence, less feed is necessary to put on a pound of gain in growth than a pound of fat.

When the cattle were shipped to the Pittsburgh market the dry-lot cattle shrank 1.8 percent and the pasture-fed cattle 4.4 percent. After outselling the pasture cattle 25 cents per cwt. the dry-lot cattle outdressed them by 1.13 percent.

The carcasses of the dry-lot cattle weighed 545 pounds cold, while the pasture lot of cattle averaged 10 pounds more.

TABLE 1.—Summary Sheet of Cattle Fed in Dry Lot Versus Cattle Fed on Pasture

Item	Dry lot	Pasture lot
Steers per lot, number	9	9
Average weight June 5, pounds	672	653
Value in feed lot June 5	$11.65	$11.65
Weight in feed lot October 30, pounds	941	999
Average daily gain (147 days), pounds	1.88	2.36
Daily ration:		
Ground shelled corn, pounds	12.81	12.74
Linseed meal, pounds	2.00	2.00
Corn silage, pounds	5.66	Blue grass
Mixed hay, pounds	1.91	pasture
Feed per 100 pounds gain:		
Ground corn, pounds	681.14	540.58
Linseed meal, pounds	106.12	84.83
Corn silage, pounds	301.29	Pasture
Mixed hay, pounds	101.29	....
Cost of 100 pounds gain	$18.51	$15.63
Necessary selling price (feed lot weight)	$13.65	$13.03
Selling price (Pittsburgh)	$16.50	$16.25
Selling weight (Pittsburgh), pounds	924	955
Shrink feed lot to market, percent	1.8	4.4
Marketing expense per cwt. (shrink included)	$ 0.77	$ 1.20
Profit per lot (steer died Sept. 29*)	$ 31.22	$184.79
Profit per lot (crediting weight of dead steer at selling price of lot)	$175.93	$184.79
Pork credit to the lot	$ 21.20	....

Corn $1.12 per bu. plus 5¢ per bu. for grinding; linseed meal $52.00 per ton; silage $6.00 per ton; hay $12.00 per ton; pasture 5¢ per steer per day.

*A steer weighing 920 pounds died suddenly September 29. This does not affect the figures on daily ration or feed for 100 pounds of gain. The profit per lot is shown charging the loss of the steer to the lot, and is also given showing results had the steer lived.

We were disappointed in not being able to get information relative to the desirability of the carcasses of the two groups. In case they were even in this respect it is apparent that much of the advantage in weight was lost by the time the cattle were on the hooks in the packing house cooler.

Two pigs following the dry-lot cattle salvaged sufficient feed to give a credit of $21.20 to the lot. No pigs followed the pasture cattle, because of fences. It is reasonable to suspect that there was about the same amount of feed to salvage had we obtained it.

A steer died suddenly September 29. Had this steer lived and continued his relative gain and sold with the other cattle, the pasture lot would have shown about a dollar per steer more profit, charging 5 cents a steer per day for pasture.

Had the cattle been sold a month earlier it is very probable that the dry-lot cattle would have been given more than a 25 cent market preference and, therefore, shown a greater profit than the pasture-fed cattle.

The results obtained in this test indicate strongly the advisability of full feeding corn to cattle on pasture and feeding long enough to obtain sufficient condition on the cattle to remove them entirely from grass cattle competition. A short feeding period on pasture will not do this.

HIGH PROTEIN GRAINS

Are They Needed as a Supplement to Pasture for Dairy Cows, II ?

A. E. PERKINS AND C. C. HAYDEN

A grain ration consisting of corn 2, oats 1, bran 1, oilmeal 1, gluten meal 1, and containing 20 percent protein; and a ration of corn 2, oats 1, bran 1, and containing 12 percent protein, were compared as supplementary feeds for dairy cows on pasture. In the first season's test, reported in the Bimonthly for May-June, 1928, little or no advantage in production or condition of animals was shown for the use of high protein supplement in the grain fed with pasture.

The second season's work showed somewhat different results. Two groups of seven crows each were fed the two mixtures as described above, in alternate periods of one month each, the two groups receiving the respective rations in reverse order. The experiment was in progress the second season during the months of July, August, and September, 1928. The permanent pasture, which was the same as described in the earlier article, was on hilly land, but parts had been improved by fertilizing and top-dressing, so that it was probably better than the average farm pasture. At the time of the experiments it was rather lightly stocked.

Silage was fed to both groups in practically equal amounts, beginning August 27, when dry weather seemed to be seriously affecting the growth and condition of the pasture. During September, when both grain and silage feeding were heaviest, approximately one-half the quantity of total digestible nutrients required for maintenance and production, according to the Morrison feeding standard, was supplied by the grain and silage.

The two groups of cows did not prove evenly balanced with respect to production. One group led thruout the summer, regardless of the feeding. The comparison, therefore, has been made by taking either the first two months, July and August, or the last two months, August and September, so that each group of cows would be represented for the same length of time on each type of feeding. The September figures were increased by 1/30 to make them comparable with those of July and August, the 31-day months.

TABLE 1.—Monthly Feed and Milk Record by Groups

Group including cow	Month	Protein content of grain	Feed supplied		Productions		Fat-corrected milk
			Grain	Silage	Milk	Fat	
			Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*
170	July	High	1,882	....	7,345.1	311.86	7,615.9
170	Aug.	Low	1,985	586	6,814.7	288.97	7,062.1
170	Sept.*	High	2,002	3,720	6,435.3	289.19	6,913.4
163	July	Low	1,612	....	6,047.6	256.41	6,264.9
163	Aug.	High	1,704	516	5,684.2	245.97	5,953.3
163	Sept.*	Low	1,674	3,596	5,235.3	228.93	5,528.2

*September calculated to 31 days for comparison with July and August.

The details regarding feeding and production are shown in Table 1. A summary of these figures and the live weight gains are shown in Table 2. The differences in the total amounts of feed consumed on the two types of ration were too small to be significant. The differences in live weight gains were also small but were greater during the periods of high protein feeding. The opposite condition in this respect prevailed in 1926.

During July and August the production was 167 pounds of milk or 12.45 pounds of fat in favor of the high-protein grain mixture—differences of 1.3 and 2.3 percent, respectively. When the results for August and September are compared, the margin in favor of the high-protein grain is reduced to 69.5 pounds milk and increased to 17.26 pounds fat. These are margins of 0.5 and 3.3 percent, respectively, over the production on the low-protein grain for the same period.

These results are somewhat different from those of the first experiment, in which little or no difference in production between the two types of feeding was found. Because the corresponding results for milk and fat do not agree closely the production is also presented as the equivalent of 4-percent milk.* These figures are shown in the last column of Table 2.

*By Gaines and Davidson's formula, the amount of 4% milk = 0.4 × observed milk production + 15 × observed fat production.

A summary drawn from them showing the amount of decline in production from one month to the next, when the cows were changed from one grain ration to the other, is also given in Table 2.

On this basis there was a difference of 242.2 pounds of 4-percent milk in favor of the high-protein grain for the July-August period, and 276.4 pounds for the August-September period.

While, from the statistical standpoint, these differences are not of great significance and may have been the result of chance variation, they seem consistently to favor the high-protein grain mixture and will be taken at their full face value in the following discussion.

TABLE 2.—Feed Consumed, Gain or Loss in Live Weight, and Production

Conditions	Feed consumed		Live weight net gain	Production		Fat-corrected milk
	Grain	Silage		Milk	Fat	
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Low protein grain, July, August	3,597	568	− 21	12,862.3	545.38	13,327.0
High protein grain, July, August	3,586	516	+ 69	13,029.3	557.83	13,569.2
Difference in production, pounds			90	167.0	12.45	242.2
Difference in production, percent			+240	1.3	2.3	1.81
Low protein grain, August, September	3,659	4,164	+347	12,050.0	517.90	12,588.5
High protein grain, August, September	3,709	4,236	107	12,119.0	535.16	12,875.2
Difference in production, pounds				69.5	17.26	276.4
Difference in production, percent				0.5	3.3	2.19
Av. coefficient of persistency of production:						
A. Changing fron high to low protein				.927	.929	.928
B. Changing from low to high protein				.942	.979	.964
Decline in production, pounds, fat-corrected milk:						
A. Changing from high to low protein						978.9
B. Changing from low to high protein						460.3

The only logical explanation for the difference between the results of the two seasons is the difference in the condition of the pasture. The first experiment was started June 1, 1927, the cows then having been at pasture several days. The grass had an excellent start and was in prime condition. Fairly dry weather in mid-summer checked the growth of the grass, but later abundant fall rains favored growth. The weeds and mature grass were mowed in July and August.

In the second experiment the cows were not turned to pasture until late in June, 1928. The grass by this time was nearly mature. Growing conditions remained favorable until mid-August, after which dry weather checked the growth of the pastures. The customary mowing of the pasture was omitted.

It has been shown by several investigators in recent years that immature grass obtained by clipping pastures at intervals of two weeks or less, contains when dried approximately 20 percent pro-

tein. This is greater than that of the best alfalfa or other legume hay, and it is a matter of common observation that such grass is highly palatable to the cow.

Grasses that are allowed to approach maturity before cutting decline in both percentage and digestibility of the protein they contain to a marked degree, so that hay from these grasses will carry only about ⅓ as much digestible protein as alfalfa hay. The palatability also is less as maturity approaches.

The conditions which prevailed in 1926 tended to produce a good supply of immature pasture thruout the season. In 1928 the relatively mature grass, which must have been of correspondingly low protein content, constituted the bulk of the pasture.

TABLE 3.—Ton Prices of Feed in Car Lots at Central Markets for Months of May to September, Inclusive

(Computed from tables in Crops and Markets, U. S. Dept. of Agr.)

Feed	1926	1927	1928
	Dol.	*Dol.*	*Dol.*
Corn	26.72	33.42	35.86
Oats	25.62	28.76	32.50
Wheat bran	28.37	32.61	33.75
Linseed oilmeal	50.12	50.00	55.00
40-percent corn gluten meal	*	46.74	55.48
Low protein grain mixture	....	32.05	34.50
High protein grain mixture	....	37.50	41.41
Difference in price per ton	....	5.45	6.91
Average difference in price per ton, including grinding charge†	....	4.86	6.32

*Quotations not available for 1926. †$2.00 per ton for corn; $3.00 per ton for oats.

It is well known that grain feeds of high protein content command a higher price on the market than corn, oats, bran, and other feeds of comparatively low protein content. To determine whether the increased production obtained in 1928 was sufficient to defray the extra expense and whether the use of the high protein supplement was profitable, it is necessary to consider the value of the product; also the cost of the respective grain mixtures.

Table 3 shows representative price quotations for the feeds used in this experiment during the years 1927 and 1928.

The prices per ton for corn, oats, and bran were very close together during the period. The difference between the average price of these grains and the average price for the high protein concentrates, 40 percent gluten meal and linseed oilmeal, was approximately $19.00 per ton. On this basis the price differential between a ton of the two mixtures was $6.18. A grinding charge of $2.00 per ton for corn and of $3.00 per ton for oats has been included in our calculations to make a fairer comparison. The

price differential between ton-lots of the two mixtures on this basis was $5.59. The price quotations available for 1926 indicate a somewhat greater difference in price for that year.

Approximately 1.8 tons of each grain mixture was fed during each two-month period under comparison. The difference in cost of this amount of grain on the basis just discussed would be $10.06. The 242.2 pounds of 4-percent milk produced by the high protein ration in excess of the other during the two-month period, July and August, at $2.50 per 100 pounds, was worth $6.05, or, $4.01 less than the extra cost of the high protein grain for that period. When the comparison is made for the two-month period, August and September, we find that the excess production of 4-percent milk, 276.4 pounds, with a value of $6.91, lacks $3.15 of paying for the extra cost of the high protein grain for that period. Combining the two periods we have a net loss of $7.16. The month of August is included twice in this summary, so that ¾ of this amount, or $5.37, represents the loss for 7 cows for the three months, or 77 cents per cow. Since in 1926 there was practically no increase in production or live weight due to the use of the high protein grain, the difference in cost of the two grain mixtures used for that season represented a total loss. At the schedule of prices named in Table 3 this loss would amount to $1.96 per cow for the season.

The price difference of $5.59 per ton on which this comparison is based assumes that all feed was bought at the prices prevailing in the great central markets. If locally-grown corn and oats are used the difference between the cost of the two mixtures would be increased.

SUMMARY

An increase of production of 2 percent was obtained from the use of a grain mixture of 20 percent total protein content in comparison with another of 12 percent protein content during the pasture season of 1928. This was contrary to the results of a previous test, probably because of difference in pasture.

The fat production was increased by the higher protein feeding proportionately more than the milk production.

When the production is stated in terms of 4-percent milk and the value of the increased production is compared with the extra cost of feed, a loss of approximately 77 cents per cow is shown for the three-month season in using the high protein grain mixture. The use of the high protein grain in 1926 represented a loss of $1.96 per cow for the four-month season.

GENETIC TESTS IN ANIMAL BREEDING

B. L. WARWICK

The art of animal breeding is one of the oldest of man's activities. It is also one of the most fascinating and has held a dignified position thru the ages. Marvelous advancement has been made and perfection of form and performance has been so nearly reached that an inspection of the best animals would lead one to think that no more advancement is possible. However, even in the best purebred herds and flocks, we find many disappointing progeny. It is not possible to tell by looking at any pair of animals whether they will "nick" well or not until tried. Of course, the better the animals and the richer the pedigree the greater the chance of superior progeny.

There are at least two aims in the breeding of high class purebreds. One is the production of a few animals that will excel any preceding animals of the same species or breed. The other is the purification and unifying of the stock to the point where culls cease to appear. The first is a laudable ambition in itself, yet we believe the second is even more desirable. In this the herd or flock should be brought to a level where 100 percent of the progeny would be as good as the best 25 percent of the present time. This would mean that the limit of variation would be small. This is the slow result of ordinary selection with rigid culling.

There are numerous specific defects, or undesirable characters, which appear too frequently in most herds and flocks. These are usually due to the appearance of recessive factors that have been carried along generation after generation in the normal, superior individuals, that have been used for parent stock. It is impossible to determine by inspection which animals carry these recessive factors, as such factors are concealed by the normal dominant factors.

Sometimes the undesirable recessive factors have been carried down thru the generations from mixed stock that was used in the formation of the breed, or from animals in its earlier history when these particular characters were not discriminated against to the same degree as at present. In many cases no animals that showed these characters have ever been used for breeding. This means

that there have been mutations in the stock, which, owing to their recessive nature, did not show up until the factors became distributed thru a large portion of the well-bred stoc

It is possible to test prospective sires to determine whether or not they carry specific recessive factors. This test can be made by breeding the prospective sire to animals carrying the recessive factors. The appearance or nonappearance of the recessive characters in the progeny would determine accurately whether or not the prospective sire carried these factors. A recessive character can not show up in the first generation when only one of the parents carries the factor.

The specific mode of procedure when making the test will depend upon whether the undesirable recessive character is due to one or several pairs of factors and upon the kind of females it is possible to use. When the defect is due to one pair of recessive factors, ten or twelve offspring out of females showing the recessive character would be sufficient. If one or more individuals among the progeny showed the recessive character, it would indicate definitely that the male used carried the factor for that recessive along with the dominant. If ten offspring in the test appeared and none showed the recessive character tested for, it would be almost a certainty that the male did not carry the recessive factor. In this case the betting odds as to the accuracy of the test would be 1023 to 1 that it was accurate. Increasing the number of progeny would bring the odds even closer to certainty.

Of course, it would also be possible to test the females, but the number of offspring from each breeding female is so small that the animal would likely be past her period of usefulness by the time the test was completed.

While these tests are not now in use by breeders of livestock, they are not new. They have been used in testing for hundreds of recessive characters in the small laboratory animals and insects. The use of this kind of a test by breeders of livestock would be the direct application of science to their work and would be another step in the purification of the breeds.

One of the recessive defects that can be tested for is black as seen in Shropshire, Merino, and most of the other common breeds of sheep. This character is being studied at this Station to confirm previous reports that the character is caused by a single pair of recessive factors. Nearly fifty black lambs have been dropped and the only exceptions to this mode of inheritance were from two ewes of known origin.

Black lambs sometimes crop out in good flocks where black parents are never used. In these cases both white parents carry the recessive factor for black. On the average, one-fourth of the lambs from this kind of mating will be black. The appearance of the rams and ewes used gives no inkling that they carry the factors for black, yet the ewes in such matings drop black lambs to the extent of 25 percent.

Where one parent is black, the color of the lambs depends upon whether or not the white parent carries the recessive factor for black along with the dominant factor for white. If the white parent does carry the factor for black, half of the lambs will be black and the other half will be white. In case the white parent does not carry the factor for black, every lamb will be white even tho one parent is black. This is the test for the black factor in a white ram, as described above.

To repeat, the appearance of a single black lamb, means that both the sire and the dam of that lamb carry the factor for black. This is true whether either parent is black or not.

There are many other undesirable characters that are either known to be inherited or probably are inherited. Of these, horns in the polled breeds of cattle, and red in Angus and Holstein cattle are definite recessives. Sires can be tested for these factors in the same way as rams are tested for black. Scrotal hernia or rupture in swine is recessive in nature, but it is due to two pairs of factors instead of one. The inheritance of other characters is being studied at this Station. These include ridgling rams, black fiber as seen mixed with white in the Down breeds of sheep, "chalk" or "frosty" face in Merinos, jar hair on the wrinkles of Merinos, and turned in eyelids of lambs. Tests for the inheritance of several defects in swine are being made. Some other characters which are not defects are being studied in sheep.

The main objection to the carrying out of test matings with prospective sires, as discussed above, is that of the cost. The breeder of high class purebred animals justly might hesitate to maintain a group of off color or defective animals for test purposes. But he could well afford to go to some expense to have his most likely males tested before mating extensively. It should be possible to have breeding farms devoted entirely to the testing of prospective sires by breeding for different recessive factors. These might be either co-operative or private enterprises if conducted with good judgment. Undoubtedly, the actual means for carrying out these tests will be forthcoming when there is enough demand.

CARROT VARIETIES

ROY MAGRUDER

In order to secure information on several new varieties of carrots that have originated and become popular in the east, nine varieties were grown in the Station gardens in 1928.

Small packets of seed, ordered by mail from the seedsmen, were planted May 10, 1928, in rows 15 inches apart in a well prepared and fertilized plot of Wooster silt loam. Level, shallow cultivation with wheel hoes was given weekly until the tops were large enough to interfere. Growing conditions were good until the latter part of August, when a two-month drouth started.

The roots in each row were dug, the tops cut off, and roots thoroly washed before the records on root characters were taken. Counts were made to obtain the number whose roots grew partly above the ground—and the number of off-type plants as regards color and shape. Shape is not so important from the market gardener's view point as off-color. These must be discarded after washing or the attractiveness of the pack will be greatly diminished. In all cases the off-color roots were lighter than the described color and might be classed as light orange yellow or pinkish yellow. These and other notes are included in Table 1.

The photograph (Fig. 1) was taken with a color filter which accentuates the difference between yellow and orange. The white or light areas in the roots are slightly more definite than they would be to the naked eye. Something of the natural variation to be expected is shown in the specimens of each variety.

All of the varieties except Amsterdam or Coreless Forcing were shorter than the standards set up by Morse (1) and Ritchie (2). This may be explained on the basis of soil type, for it is widely recognized among growers and seedmen that the longest and smoothest roots are obtained on the lighter textured soils. The soil on which this test was made is rather heavy and compact. Exceptionally heavy rainfall during June may have been partly responsible for shallow rooting and consequently short roots.

VARIETAL NOTES

Amsterdam or Coreless Forcing—Harris.—Top small with finely cut leaves. Not suitable for bunching because of small, brittle tops, easily broken from the roots. Roots rather small,

(1) Morse, Lester L. Field Notes on Carrots. C. C. Morse & Co. San Francisco, 1925.

(2) Ritchie, T. F. Standard Descriptions of Vegetables, Beets and Carrots. Dom. of Canada, Dept. of Agr. Bul. 82, New Series.

slender, cylindrical with dark orange flesh and small indistinct, dark orange colored core. Slightly constricted by lenticel-like depressions whence the lateral roots arise. So-called "coreless" type because of indistinct core, which is almost as dark in color as surrounding flesh. See Figure 1, No. 1. One of the finest quality and recommended for home gardens. A fairly uniform strain in shape and very good in color.

TABLE 1.—Notes on Carrot Varieties, 1928

Variety	Seedsman	Root		Green tops	Off-type	
		Length	Diameter		Shape	Color
		In.	*In.*	*Pct.*	*Pct.*	*Pct.*
Amsterdam Forcing	Harris	4 —5	1 —1¼	18.5	7.2	.0
Coreless Forcing	Woodruff	4 —5	1 —1¼	13.4	10.3	.0
Nantes	Woodruff	4 —5½	1¼—1¾	41.0	14.7	2.2
Chantenay	Woodruff	3½—4½	2 —2½	16.3	15.2	3.2
Select Danvers	Woodruff	5 —6	1¾—2¼	51.9	4.4	24.0
Bagly	Woodruff	6 —7½	1¾—2¼	49.0	7.2	9.1
Hutchinson	Woodruff	6 —7½	1¾—2¼	52.6	5.3	10.7
Pride of Denmark	Harris	6 —7½	1¾—2¼	13.4	14.9	20.9
Perfection	Woodruff	6 —7½	1¼—2	21.5	.0	11.8

Coreless Forcing—Woodruff.—Of the same general type as the Harris strain, but there seemed to be two distinct lengths, one 4 inches long and the other 6 inches long.

Nantes—Woodruff.—The same cylindrical shape as in Coreless Forcing, but larger in diameter with a larger, stronger top. The core larger in proportion to the diameter than that of Coreless Forcing but fairly indistinct in most roots. Flesh dark orange in color and of high quality. One of the highest quality bunching carrots for the home market but so brittle when well grown that it breaks badly in shipment. Figure 1, No. 2.

Chantenay—Woodruff.—An old variety much used on the heavier types of soil or where large tonnage per acre is desired. Top large, vigorous. Roots thick, slightly tapering to a blunt tip with rather large distinct core. The core is usually lighter in color than the surrounding flesh also occasional specimens were found in which it was dark orange like the flesh. Figure 1, No. 3.

Select Danvers—Woodruff.—Another old and popular variety. Not as thick but longer and tapering more abruptly to a point than Chantenay. Top slightly heavier than Chantenay. Skin usually dark orange; the large core usually orange yellow to yellow in color and sometimes with a dark orange streak in the center. An attractive carrot for bunching but not as long nor as smooth on heavy soils as on light sandy or sandy loam soils. Figure 1, No. 4.

Bagly—Woodruff.—Might best be described as a long Danvers; somewhat lighter in color than the Danvers, from the same source. Bagly, which is a selection from Hutchinson, is supposed to grow entirely under the ground and therefore have no green tops; but on this heavy soil it was no better in this regard than Hutchinson. A very attractive bunch carrot, extensively used for the New England and eastern markets. Figure 1, No. 5.

Hutchinson—Woodruff.—Identical with Bagly, altho supposed to have more green top on the roots as the result of its growing partly above the soil.

Pride of Denmark—Harris.—The same shape and size as Bagly, but true-type roots darker orange in color.

Perfection—Woodruff.—More slender than Bagly with a straight line taper from top to tip. Color darker, the same as Nantes, and root slightly constricted by the lenticels, which are close together. Core small and indistinct. Very good quality, but late maturing.

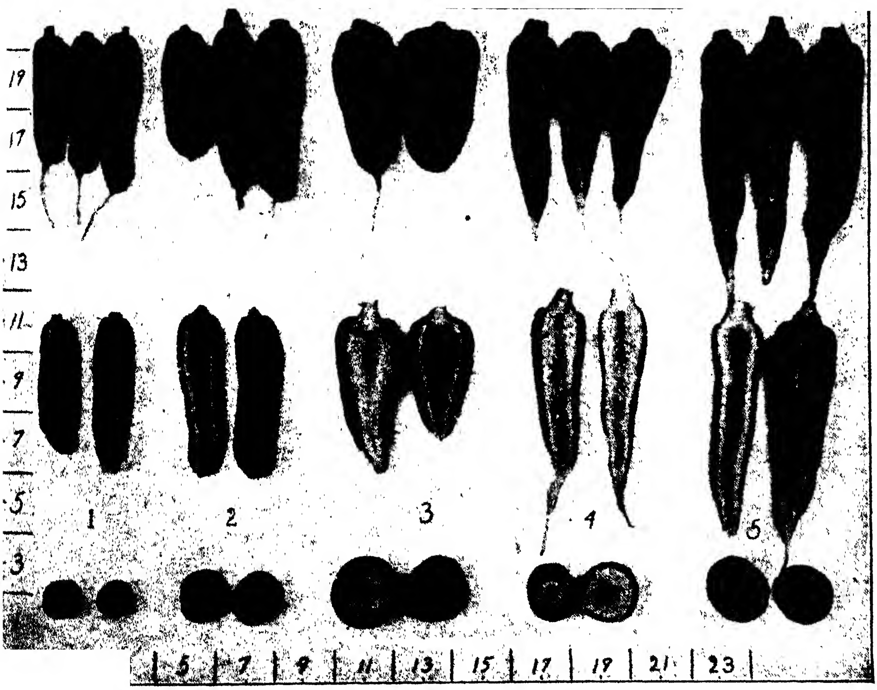

Fig. 1.—Sectional view of carrot varieties showing relative size, shape, smoothness, color, size and color of core, etc. 1. Amsterdam or Coreless Forcing. 2. Nantes. 3. Chantenay. 4. Danvers. 5. Bagly. White or light flesh color in figure represents yellow, and dark represents orange flesh color.

THE FEATHER MITE* IN OHIO

Also Known as the Tropical Fowl Mite With Notes on a Valuable Aid in Its Control

C. R. CUTRIGHT

This mite, according to the U. S. Department of Agriculture, has been reported in the United States about twelve times, in numbers that were commercially injurious. Dr. A. E. Miller reports that it has been collected several times in Ohio and that it may become a very serious pest of poultry.

During January, 1929, a commercial poultryman near Wooster, Ohio, noticed that an occasional mite was to be found on newly laid eggs. As time passed the numbers found increased until almost every egg collected had on it from one to fifty or more mites. Advice was asked of the Ohio Agricultural Experiment Station and, as it was not suspected that the mite could be any other than the common chicken mite, the usual control by painting, spraying of houses, and dipping of fixtures with creosote 20 percent and kerosene or basal oil 80 percent was recommended. This treatment was faithfully carried out but the owner found it almost a total failure. A personal examination was then made by a Station entomologist and it was found that mites in great numbers were present at all times on the fowls. Collections of the mites were made and forwarded to specialists of the U. S. Department of Agriculture at Washington, D. C., and to Dr. A. E. Miller of Zanesville, Ohio. All identified the species as the feather mite.

Life-history and habits.—The mites spend almost the entire period of the life cycle on the fowls but some may be found on eggs and in the nests. They have not been collected by us from positions other than those enumerated but undoubtedly may be found on dropping boards and floors in small numbers. While on the birds the mites are usually found in greatest abundance in the fluff feathers below the vent. The eggs for the most part are laid in this general area and most of them adhere to the feathers, tho the mite does not actually attach them as is the case with certain other poultry parasites. Eggs that were laid by mites kept in vials in the laboratory hatched in three days. They are pearl white in color; are a short oval in shape; and are considerably shorter than

*Liponyssus sylviarum.

the eggs of the body louse. There are no specific data as to the length of time required for the mite to mature and lay eggs but it is probably not more than two or three weeks.

Injury.—The finding of mites on newly laid eggs seems to be a characteristic sign of infestation. Infested fowls have the fluff feathers beneath the vent badly fouled and matted by moulted skins, bloody excrement, and the eggs of the mite. Scabby areas caused by continued feeding of the mites are frequently found in the same location. While we have no instances of the mites' proving fatal to birds, several such cases are mentioned in the literature.

Fig. 1.—A typical fluff feather injured by feather mites (above). Bits of fluff feathers (below), showing eggs, egg shells, and cast skins of the feather mite.

Control.—Since the infestation was discovered in mid-winter the usual control measure of dipping in a sulfur-soap solution was not practicable. Therefore a small-scale experiment with nicotine sulfate painted on the perches, as has been successfully employed for the control of the body louse, was arranged. The perches in a small section of one of the houses were painted with the nicotine about one-half hour before the birds started to roost. Large sheets of white paper were placed on the droppings boards so that any mites falling from the fowls might be recovered. Results showed that within 15 to 30 minutes after the birds went to roost, mites

began to fall to the paper. In about three hours the sheets were removed and large numbers of dead mites were found on all of them. Of the few mites that showed signs of life, none recovered.

Encouraged by the results of this small experiment the perches in the entire house were treated the following night, nests were also cleaned and the new nesting material was treated with a fine dusting sulfur. Results that can be considered no less than remarkable came from this treatment. No mites have since been found on the eggs in a period of about five weeks, whereas before the treatment the number of mites found on eggs easily ran into the thousands each day. An examination before treatment failed to find a single uninfested fowl, while since the treatment not one infested individual has been located. While there were some indications that the eggs of the mites were affected by the treatment it would seem advisable that the work be repeated after an interval of about seven days in order that any newly hatched mites would be destroyed.

Despite the remarkable results obtained from the application of nicotine sulfate it is doubted if it could be completely depended upon for eradication. Therefore in connection with its use and under the proper weather conditions, it is advisable to treat each bird individually, either dusting it with finely ground dusting sulfur or flowers of sulfur, or dipping in a solution made according to the following formula, which is advised by the U. S. Department of Agriculture.

Soap (any brand)	1 oz.
Flowers of sulfur	2 oz.
Water	1 gal.

Either dipping or dusting should be thoro. In addition to treating the birds, the roosts, nests, droppings boards, walls, and floors should be sprayed or painted with carbolineum or with a mixture of creosote oil 20 percent and kerosene 80 percent. Nesting material should be kept treated with sulfur dusts.

A program based on the immediately preceding recommendations has in almost every instance, according to the workers in the U. S. Department of Agriculture, given complete control of the mite. However, under urgent conditions where relief is needed and where weather or housing conditions prohibit a general cleanup program, nicotine sulfate is a certain means of effecting an immediate, commercial control.

THE BEHAVIOR OF THE CORN BORER IN STORED CORN

J. B. POLIVKA AND E. A. HERR

In order to determine the importance of crib corn as a hibernating place for corn borer larvae and as a possible source of reinfestation, the borer population in 50 cribs distributed over the heavily infested Bono, Ohio, area was determined in April and May of 1927. The total number of bushels of corn stored in the cribs was 39,800, or an average of about 800 bushels per farm. The population was found to be about two borers per bushel, thus making the borer population per farm in stored corn around 1600.

Before the moth flight period, late June and early July, many of the farmers either had sold their corn or fed it. It was estimated that one-half of the total amount of stored corn was sold before the moth flight period, which left only 800 borers per farm. One-half of the remainder was fed before the period of moth emergence, thus leaving an average of about 400 borers in crib corn per farm available for reinfestation.

Other records taken at Oak Harbor in 1927 show that the average number of borers per acre in the debris from the previous year's corn fields amounted to 378 at the close of the clean-up period. From this record it is evident that the average number of borers per farm in ear corn at the time of moth flight was equivalent to a little more than the average number per single acre on corn ground of the previous year.

PERIOD OF EMERGENCE FROM CRIB CORN

In order to ascertain the period of emergence and the percentage of borers able to emerge from crib corn, 600 infested ears were procured from cribs and placed in suitable cages simulating crib conditions. By the use of these cages daily emergence records were obtained. Emergence from ear corn started on July 8 and continued until September 21, after which no moths were obtained. A comparison of the emergence from crib corn with that of normal field emergence clearly showed that dry storage conditions retard the emergence of moths. Apparently, when all the moths had emerged in the field, those in crib storage had just begun. Emergence from crib corn was long drawn out while the normal field emergence was completed by July 14.

Dissection of the ears late in September showed that 54 percent of the borers had emerged as adults, 23 percent were still living larvae, 18 percent had died in the larval stage, and 5 percent had perished in the pupal stage. In making the dissections, all living larvae were saved in order to determine if any of them would carry over to the next season. They were placed in corrugated paper strips and kept under dry storage conditions. By November 22 there were but few living larvae remaining and these soon died. Hence the late September record may be considered as final.

TABLE 1.—Number and Condition of Borers in Lots of 100 Ears of Corn Dissected at Different Dates

Date of dissection	Ears dissected	Total borers	Live larvae	Dead larvae	Live pupae	Dead pupae	Emerged
	No.	*No.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
July 15	100	57	42.1	1.7	43.9	0	12.3
July 25	100	52	55.8	3.8	13.5	0	26.9
Aug. 5	100	63	49.2	9.5	7.9	3.2	30.2
Aug. 20	100	42	42.2	17.8	2.2	6.7	31.1
Sept. 24	100	50	16.0	30.0	0	6.0	48.0

In order to get further evidence regarding the seasonal history and behavior of the borer in the crib, additional experiments were conducted at Bono, Ohio. Five hundred infested ears were procured and placed in a series of 5 cages amid other corn in a crib. Each cage was tightly covered with 18-mesh screen and buried in corn in the crib, thus placing it under conditions identical with normal crib storage. Corn from these cages was dissected at intervals for development and mortality records, as shown in Table 1.

TABLE 2.—Summary of Results From Two Series of Ear Cages

Location of cages	Percent of total borers not developing beyond the larval stage	Percent of total borers not developing beyond the pupal stage	Percent becoming moths
Oak Harbor	40.5	46.5	53.0
Bono	46.0	52.0	48.5
Av. of 2 series	43.3	49.3	50.7

In the first dissection, on July 15, only one dead larva was found, but the number of dead larvae increased at each succeeding dissection period until at the final one on September 24, a larval mortality of 30 percent was reached. The emergence prior to July

15 was 12.3 percent as compared to 48 percent in the final dissection, September 24. These data show that at Bono during 1927 the larval mortality of borers in crib storage was high, and that not quite one-half of the larvae transformed into moths.

It may be noted in Table 2 that the two records of behavior under storage conditions are closely comparable. The combined results show that about 43 percent of the total borers in crib storage during 1927 did not develop beyond the larval stage. About 49 percent of the total borers in crib storage did not develop beyond the pupal stage, leaving 51 percent that became moths.

SUMMARY

1. The amount of corn carried over during the moth flight period for the average farm in the Bono area (east Lucas County) in 1927 was found to be around 200 bushels; this amount of corn carried a total population of approximately 400 borers.

2. The moth emergence period in stored corn was much extended as compared to the normal emergence period. Moths from dry storage material began emerging in the fore part of July and continued slowly thruout July, August, and September, whereas the normal emergence period was over by July 14.

3. Approximately one-half of the borers in crib corn failed to become moths. From the viewpoint of damage to the corn crop the progeny of the moths which do emerge late is considered of negligible consequence. Hence under conditions as described above, that is, where ear corn is kept dry, the borers contained therein are not held to be an important source of reinfestation in Ohio. This same conclusion is held with respect to the borers over-wintering in barn-stored fodder.

THE PRICE OF OHIO WHEAT

J. I. FALCONER

Ohio wheat growers were dealt a severe blow in 1928 with a wheat crop of not over 30 percent of normal. With regard to price, however, the Ohio farmer fared better than the average wheat grower of the nation. The Ohio crop falls largely in the class of soft red winter wheat. Approximately one-fourth of the total wheat acreage and nearly one-half of the winter wheat acreage are in this class. The leading states in its production, are Missouri, Indiana, Ohio, and Illinois. It is used in the manufacture of both bread-making and pastry flours.

The prices of the various classes of wheat tend to fluctuate more or less independently from year to year according to their production. In the table below are given the total production of all classes of wheat and of soft red winter wheat in the United States by years since 1922. The two do not fluctuate together. In 1928, for instance, there was the largest total production, but the smallest production of soft red winter wheat.

TABLE 1.—Production and Prices of All Classes of Wheat and of Soft Red Winter Wheat

Year July to June	U. S. production		Price per bushel		
	All classes	Soft red winter	All classes and grades Chicago	No. 2 soft red winter cash Toledo	Premium: No. 2 red winter over all classes and grades
	1,000 *Bu.*	1,000 *Bu.*	*Dol.*	*Dol.*	*Dol.*
1922—23	....	....	1.16	1.28	0.12
1923—24	797,394	271,631	1.06	1.10	.04
1924—25	864,428	189,441	1.54	1.66	.12
1925—26	676,429	169,792	1.59	1.72	.13
1926—27	831,040	228,040	1.31	1.40	.09
1927—28	878,374	180,887	1.37	1.54	.17
1928	902,749	139,788	1.12	1.48	.36

The prices given are a monthly average for all classes and grades of wheat on the Chicago market and for No. 2 red winter wheat on the Toledo market. It is evident from the table that the price of wheat to the Ohio farmer on the supply side was influenced both by total production of all wheat and also by the production of that particular class of wheat which the Ohio farmer grows, namely, soft red winter. From July to December, 1928, the Toledo price of No. 2 soft red winter wheat exceeded the Chicago average price of all classes and grades by 35 cents.

REAL ESTATE TAX AND INCOME TO OWNER ON CASH-RENTED FARMS IN CENTRAL OHIO

H. R. MOORE

The greater part of the tax paid on farm property in Ohio is paid on real estate. Averages for the State indicate that 77 percent of the farmers' tax is paid on land and buildings. Information collected from cash-rented farms is fairly indicative of the relation existing between the real estate tax and the income which may be realized from the land alone. A study relative to this is being conducted by the Department of Rural Economics at the present time.

A survey of approximately 50 cash-rented farms in Madison County and southern Union County yielded the following results expressed as averages per acre:

Cash rent	$5.94
Landlord's expenses other than taxes	1.36
Real estate tax	1.57
Net rent before deducting tax	4.58
Net rent, tax deducted	3.01

On the farms considered, taxes amounted to 34.28 percent of the rent after the expenses other than taxes had been deducted. Before deducting any expenses, taxes represented an amount equal to 26.43 percent of the cash rent. The foregoing were based on rents and taxes paid in the year 1928.

Expenses paid by the landlord, other than taxes, were building insurance; depreciation and repair of buildings, fences, drainage systems, and, in some cases, the cost of grass seed. When the tenant furnished the seed it is probable that a little lower cash rent was paid. No deduction in these calculations was made for the expense of supervision or management by the landlord or his agent. In some cases this expense was a tangible item. In others it was negligible. The concensus of opinion seemed to be that in the long run the annual cost of supervision by the landlord would be approximately fifty cents per acre.

PRODUCE RECEIPTS BY RAIL AND BY TRUCK ON THE COLUMBUS WHOLESALE MARKET, JULY 2—DEC. 31, 1928

CHAS. W. HAUCK

During the six months July 2 to December 31, 1928, inclusive, 3,652 carlots, or more than 100 million pounds of fruits and vegetables were received by rail in Columbus. During the same period 7,025 truck loads, aggregating over 13 million pounds, were received on the wholesale produce market. Truck receipts constituted 11.7 percent of the whole.

TABLE 1.—Average Daily Receipts by Truck on Columbus Wholesale Produce Market, July 2—December 31, 1298

Day of week	Receipts		Trucks	
	Lb.	*Pct.*	*No.*	*Pct.*
Monday	50,306	9.5	26	9.3
Tuesday	107,179	20.3	60	21.5
Wednesday	73,138	13.8	36	12.9
Thursday	99,007	18.6	52	18.6
Friday	60,134	11.3	29	10.4
Saturday	140,678	26.5	76	27.3
Total	530,442	100	279	100

The average truck load weighed 1,897 pounds net. The average one-way haul was 30.29 miles, tho almost 60 percent of the trucks, those from Franklin County, traveled not more than 10 miles each. The longest haul was made by three trucks originating at Kalamazoo, Michigan, a distance of about 340 miles. The total round trip distance traveled in delivering the 7,025 truck loads to the Columbus market was 425,570 miles.

TABLE 2.—Monthly Receipts by Rail and by Truck on Columbus Wholesale Produce Markets, July 2—December 31, 1928

Month	Carlot receipts	Truck receipts	Total	Truck receipts
	Lb.	*Lb.*	*Lb.*	*Pct.*
July	22,384,000	934,341	23,318,341	4.0
August	18,395,000	4,165,252	22,560,252	18.5
September	15,113,000	3,753,346	18,866,346	19.9
October	21,634,000	3,022,598	24,656,598	12.3
November	13,570,000	1,128,955	14,698,955	7.7
December	9,582,000	323,973	9,905,973	3.3
Total	100,678,000	13,328,465	114,006,465	11.7

Truck receipts constituted almost 20 percent of the total in August and September, but only about 3 percent in December.

On the average more than one-fourth of the total weekly truck arrivals were received on Saturday. The arrivals on Tuesday, Thrusday, and Saturday represented about two-thirds of the total weekly receipts. Daily offerings ranked in the following order: Saturday, Tuesday, Thursday, Wednesday, Friday, and Monday.

TABLE 3.—Produce Receipts by Rail and by Truck in Columbus, July 2—December 31, 1928

Commodity	Carlot receipts	Truck receipts	Total	Received by truck
	Lb.	*Lb.*	*Lb.*	*Pct.*
Apples	4,773,000	2,916,409	7,689,409	37.9
Bananas	4,893,000	...	4,893,000	...
Beans (green)	17,000	325,096	342,096	95.0
Beans (lima)	...	45,681	45,681	100.0
Beets	...	155,392	155,392	100.0
Blackberries	...	62,852	62,852	100.0
Cabbage	1,326,000	798,315	2,124,315	37.6
Cabbage sprouts	...	26,910	26,910	100.0
Cantaloupes	6,100,000	38,330	6,638,330	8.1
Carrots	...	227,640	227,640	100.0
Cauliflower	651,000	52,980	703,980	7.5
Celery	1,360,000	420,864	1,780,864	23.6
Chinese cabbage	...	12,949	12,949	100.0
Corn	85,000	2,434,847	2,519,847	96.6
Cranberries	714,000	...	714,000	...
Cucumbers	85,000	329,172	414,172	79.5
Currants	17,000	...	17,000	...
Dewberries	120,000	...	120,000	...
Eggplant	...	32,027	32,027	100.0
Elderberries	...	921	921	100.0
Endive	...	28,221	28,221	100.0
Grapefruit	1,980,000	...	1,980,000	...
Grapes	14,619,000	13,707	14,632,707	.1
Honeydew melons	336,000	...	336,000	...
Kale	...	37,248	37,248	100.0
Lemons	2,130,000	...	2,130,000	...
Lettuce	3,528,000	96,626	3,624,626	2.7
Mustard	...	20,335	20,335	100.0
Onions (dry)	3,175,000	129,543	3,304,543	3.9
Onions (green)	...	57,333	57,333	100.0
Oranges	11,772,000	...	11,772,000	...
Parsley	...	7,451	7,451	100.0
Parsnips	...	68,555	68,555	100.0
Peaches	10,604,000	109,463	10,713,463	1.0
Pears	1,386,000	96,814	1,482,814	6.5
Peas	...	10,742	10,742	100.0
Peppers	...	340,913	340,913	100.0
Pineapples	20,000	...	20,000	...
Plums	1,188,000	14,677	1,202,677	1.2
Potatoes	13,824,000	1,542,946	15,366,946	10.0
Pumpkins	...	62,898	62,898	100.0
Quinces	44,000	1,791	45,791	3.9
Radishes	...	39,481	39,481	100.0
Raspberries	...	11,823	11,823	100.0
Rhubarb	...	638	638	100.0
Salsify	...	3,738	3,738	100.0
Spinach	96,000	147,373	243,373	60.5
Squash	...	114,848	114,848	100.0
Strawberries	...	392	392	100.0
Sweet potatoes	3,872,000	...	3,872,000	...
Tangerines	168,000	...	168,000	...
Tomatoes	777,000	1,516,411	2,293,411	66.1
Turnips	384,000	350,277	734,277	47.7
Watermelons	10,250,000	123,836	10,373,836	1.2
Mixed vegetables	384,000	...	384,000	...
Total	100,678,000	13,328,465	114,006,465	11.7

AGE DISTRIBUTION OF OHIO FARM POPULATION

P. G. BECK

According to Federal census reports Ohio's farm population decreased by 107,000 persons between the enumerations of 1920 and 1925. Data taken by us during 1927 and 1928, on 1080 farm households indicate that most of this loss of population occurred in the 20-39-year age group. The 1080 families represent samples studied in areas of different types of farming located in different sections of the State. In the table the data on age distribution gathered from these households are compared with the same age distribution of Ohio farm population and the total population of the State for 1920.

TABLE 1.—Age Distribution of 1080 Farm Households in 1927-28, Ohio Farm Population, 1920, and Total Population of Ohio, 1920, Compared

Age in years	1080 farm households, 1927—28	Ohio farm population, 1920*	Ohio total population, 1920
	Pct.	*Pct.*	*Pct.*
Under 20	43.1	41.5	36.6
20—39	22.6	26.1	33.7
40—59	22.1	21.7	20.8
60 and over	12.2	10.7	8.9
Total	100	100	100

*Computed from data in "Census Monograph VI, 1920," page 194.

It will be noted that in both distributions of the farm population the number in the 20-39-year group is decidedly less than in the "under 20" group. This difference is due largely to migration of persons 20-39 years of age from farming to other occupations. Note the higher percentage of persons in the 20-39-year age group in the total population than in the farm population. In the farm population there was a much greater percent of persons under 20 and over 59 years of age than in the total population, which means a greater ratio of dependents. This is counteracted in part by the earlier age of employment of farm children than of urban children.

Another fact to be noticed, if our samples be representative of the farm population of Ohio, is that the percentage of persons 20-39 years is less in the 1080 farm households than in the farm population of the State in 1920. This is in harmony with other data available which indicate increased migration from farming during the intervening years. Other data at hand, however, lead us to believe that this migration has been less during past year or two.

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

Data available as of March 1, 1929 indicate that the decline of Ohio farm land values has been somewhat checked. From March 1928 to March 1929 the reported decrease in value was 2 percent. From 1920 to 1927 the fall in value was rapid, declining from a value index of 159 in 1920 to 99 in 1927. For the last two years this rate of decline has been somewhat checked, the index reaching 94 this spring. It is interesting to note that the value of Ohio farm real estate is now the same as it was in 1910. In the table there is appearing for the first time a revised index of the "Ohio cash income from farm sales". The new index has as its base the years 1910 to 1914, thus placing the index on the same base period as the others in the table. The gross income from cash sales was ten points lower in 1928 than in 1927.

Trend of Prices and Wages, 1910-1914=100

	Wholesale prices all commodities U. S.	Weekly earnings N. Y. state factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm products prices	Ohio cash income from sales
1913	102	...	100	100	104	100	104	104
1914	100	100	101	102	102	102	105	109
1915	103	101	106	100	103	107	106	109
1916	130	114	123	117	113	113	121	119
1917	181	129	150	176	140	119	182	191
1918	198	160	178	200	175	131	203	242
1919	210	185	205	209	204	135	218	268
1920	230	122	206	205	236	159	212	225
1921	150	203	156	116	164	134	132	129
1922	152	197	152	124	145	124	127	127
1923	156	214	153	135	166	122	134	137
1924	152	218	154	134	165	118	133	139
1925	161	223	159	146	165	110	159	147
1926	154	229	156	136	170	105	155	156
1927	149	231	154	131	173	99	147	144
1928	153	212	156	139	169	96	153	134
1928								
January	151	230	...	137	158	...	141	139
February	151	230	...	135	...	...	141	127
March	150	233	155	137	...	98	145	126
April	152	227	...	140	172	96	152	127
May	154	230	...	148	...	...	167	135
June	153	232	157	145	...	...	163	142
July	154	230	...	145	173	...	162	132
August	155	231	...	139	...	...	158	119
September	157	234	156	141	...	...	158	121
October	153	234	...	137	174	...	153	139
November	151	233	...	134	...	...	146	151
December	151	237	...	134	...	...	147	151
1929								
January	152	234	156	133	166	...	144	141
February	...	...	...	...	...	94	149	133

FIELD DAYS AT THE EXPERIMENT STATION

Livestock Days, Wooster, April 19; Kenton, April 22; Columbus, April 24; and Cincinnati, April 26.

Lawn Day, Saturday, June 8.

Poultry Days, Thursday and Friday, June 20 and 21.

Wheat and Clover Days, Wednesday and Thursday, June 26 and 27.

Seedsman's Day, Thursday, August 1.

Dairy Day, Friday, August 15.

Orchard Day, Friday, August 16.

Corn and Soybean Day, September ——.

These days are planned so as to give visitors an opportunity to see the various experiments at a time when the results can be studied to advantage and explained by members of the Station staff in charge. Many delegations and individuals visit the Station on other days and are always welcome, but those who come on the special days will have the additional advantage of hearing the discussions and one or more distinguished speakers.

The Lawn Day program will include inspection and discussion of the lawn grass experiments; methods of establishing new lawns—soil treatment, rate, time, and method of seeding, etc.; thirty different kinds of turf grass; shady grass experiments; lawn improvement—fertilizers, weed eradication, methods of mowing, watering, etc.; inspection of arboretum of forest trees and ornamentals; exhibit of grass seeds, lawn fertilizers, weed specimens, weed killers, implements for spreading fertilizers, spraying, seeding, etc., and talks by authorities on soils and lawn grasses.

Poultry Days—Specialists of the Experiment Station and of the Extension Service of the Ohio State University will cooperate in presenting the results of research and experiments and the latest developments of interest to poultry keepers. This event attracts two to three thousand visitors each year.

On **Wheat and Clover Days** visitors may see 65 varieties of wheat, including many new selections, growing side by side; 75 varieties and selections of oats, barley, and spring wheat; 50 different crop rotations; many strains of alfalfa and clover; corn showing the effect of different kinds, amounts, and methods of applying fertilizers in hastening development and increasing yield; the effect of different liming materials, used in varying amounts, and applied to different crops in the rotation.

Seedsman's Day will include discussions of topics of special interest to seedsmen and inspection of the variety and breeding work with oats, barley, corn, and soybeans; alfalfa strain tests; lawn grass experiments; variety and breeding work with vegetables and flowers; spraying of fruits and vegetables.

The programs of Orchard Day, Dairy Day, and Corn and Soybean Day will be announced in the July-August issue of the Bimonthly Bulletin.

The Bimonthly Bulletin

July-August, 1929 Number 139

Ohio Agricultural Experiment Station

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Free Bulletin

C. G. Williams

Director

The Station Poultry Plant, as seen from the northwest

TIMOTHY FOR HAY SEEDED IN WHEAT AT DIFFERENT TIMES AND RATES

MORGAN W. EVANS[1]

In Ohio most of the timothy and clover meadows are sown with winter wheat as a nurse crop. The clover is sown on the surface of the soil in the spring. The practice in sowing the timothy varies: some farmers sow all of the timothy at the same time as the wheat in the fall; some sow it at the same time as the clover in the spring; and others sow part in the fall and part in the spring.

Experiments have been conducted at the Timothy Breeding Station[2] at North Ridgeville, Ohio, for the purpose of determining the effect of time and rate of sowing timothy, on the following hay crops. The experiment has been repeated in several series of plots, sown in different seasons. The results show quite conclusively that the quantity and the quality of hay may be affected to a marked degree by the time and rate of sowing the seed.

These experiments were conducted with winter wheat as a nurse crop. It may be assumed that the results would not be materially different if winter rye were used. On the other hand, when timothy and clover are sown in the spring, with spring wheat, barley, or oats, according to results which have been obtained at North Ridgeville and at other agricultural experiment stations, if the timothy is sown at a heavier rate than is necessary for a good stand, the plants do not make large enough growth to injure the clover or to cause a decrease in the yield of hay—as has been found to be the case when it is sown at an excessive rate in the fall with winter wheat.

TIME OF SEEDING TIMOTHY

In each of four seasons, timothy was sown in one set of plots at the same time as the wheat in the fall at the rate of 10 pounds per acre, and in another set it was sown at the same rate in the spring. In both series 10 pounds of red clover seed per acre was sown in the spring.

In one of the series, timothy was sown with wheat on some of the plots in the fall of 1923, and on others at the same time as the clover seed in the spring of 1924. The timothy sown in the fall

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[2]Conducted cooperatively by the Ohio Agricultural Experiment Station and the United States Department of Agriculture.

produced a dense stand. That sown in the spring made a good stand but it did not make as large growth in that season as the fall-sown timothy. The clover, on the other hand, grew much better where the timothy was sown in the spring. Figure 1 shows the larger proportion of timothy and smaller proportion of clover in the hay in the fall-sown timothy plot. The yields of hay harvested from these plots in 1925 and 1926 are given in Table 1.

TABLE 1.—Yield of Air-dry Hay Produced in Plots Where the Timothy was Sown in the Fall, and in Plots Where it was Sown in the Spring

Rate per acre and time of sowing	Yield, pounds hay per acre			
	1925		1926	Total
	Crop 1	Crop 2		
10 pounds timothy in fall 10 pounds red clover	2026	1286	2325	5637
10 pounds timothy in spring 10 pounds red clover	2627	1459	2598	6684

Note—The first crop of hay harvested in 1925 was composed of mixed timothy and clover; the second crop was chiefly of clover. In 1926 clear timothy hay was produced in these plots.

In the plots where the timothy was sown in the fall, the first crop of mixed hay contained 49 percent of timothy and 51 percent of clover. In the plots where the timothy was sown in the spring, there were 15 percent of timothy, 84 percent of clover, and 1 percent of weeds.

In one of the four series of plots, larger yields of hay were harvested where the timothy was sown in the fall than where it was sown in the spring. In all of the other series the results obtained were similar to those given in Table 1.

In the 42d annual report of the Ohio Agricultural Experiment Station, published in 1923, there is a record of an experiment in which the effect of sowing timothy in the fall is compared with the effect of spring sowing upon the yields of wheat. The following results were reported at that time.

TABLE 2.—Effect of Timothy Seeded in Wheat on Yield of Wheat

Time and rate of sowing	Three-year average yield of wheat per acre
10 pounds in fall	33.78 bushels
5 pounds in fall and 5 pounds in spring	35.41 bushels
10 pounds in spring	36.39 bushels
No timothy	36.93 bushels

The comment was made that "To date the fall seeding of 10 pounds of timothy seems to have reduced the yield of wheat about 3 bushels per acre."

EFFECT OF SOWING TIMOTHY AT DIFFERENT RATES IN THE FALL

The results seem to indicate that it is advisable to sow the timothy seed at the same time as the clover in the spring. Many farmers, however, have found by experience that it is not always safe to defer sowing timothy until spring. In most seasons timothy sown with the wheat in the fall will grow, whereas it not infrequently happens that weather conditions in the spring are unfavorable for germination and growth. Rather than take the risk of having a good stand of neither timothy nor clover in the meadows, most farmers sow either all or part of timothy at the same time as wheat in the fall.

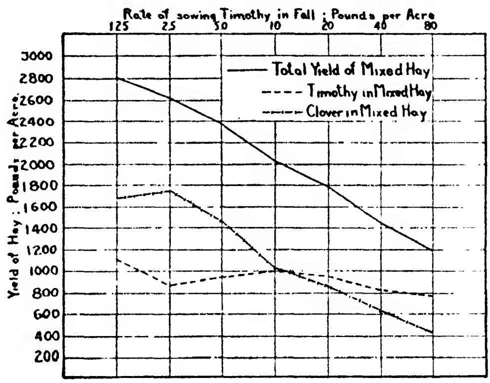

Fig. 1.—Effect of time and rate of sowing timothy on hay crop. Records obtained in 1925

In each of the four series, timothy has been sown at different rates at the same time as the wheat in the fall. In one set of plots in each series, part of the timothy has been sown with the wheat in the fall, part with the clover in the spring. A record from the mixed timothy and clover hay harvested in 1925 is given in Table 3. An unusually uniform, well distributed stand of both timothy and clover was obtained in this series

Samples were collected from the first crop. The timothy, clover, and weeds were separated from each sample, dried, and weighed. The percentage of each is given in the table.

The yields of hay in 1925 and 1926 are recorded in Table 3. The yields of timothy and of clover in the first crop of mixed hay harvested in 1925 were calculated by multiplying the total yield per acre by the percent of timothy and of clover.

Mixed timothy and clover hay was harvested in another series of plots in 1927, and clear timothy from the same plots in 1928. The crop of timothy and clover harvested in 1927 was grown under

weather conditions quite different from those for the crop harvested in 1925. During the winter of 1926-27 the clover was winter-killed on about one-half of the acre in each plot, leaving on the other half a stand of nearly clear timothy. Notwithstanding the differences in conditions for the growth of the mixed timothy and clover crops harvested in 1925 and 1927, the effect of sowing timothy at different rates, upon the proportion of timothy and clover, and upon the yield, were much the same in the two tests. The records obtained from these plots are shown in Table 4, and are presented graphically in Figure 2.

TABLE 3.—Yields of Air-dry Hay in 1925 and 1926 and Percentage of Timothy, Clover, and Weeds in First Crop of 1925

Seeding	Seed per acre	Yield per acre: Total 1925	Yield per acre: Total 1926‡	1925 crops: First, Timothy	1925 crops: First, Clover	1925 crops: Second†	Percentage per acre in first crop 1925: Timothy	Clover	Weeds
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Pct.*	*Pct.*	*Pct.*
Timothy in fall Red clover*	1.25 10.0	2806	2780	1112	1675	1471	39.62	59.68	0.70
Timothy in fall Red clover	2.5 10.0	2623	2802	879	1741	1365	33.53	66.36	.11
Timothy in fall Red clover	5.0 10.0	2380	2701	941	1438	1292	39.55	60.43	.02
Timothy in fall Red clover	10.0 10.0	2026	2325	996	1026	1286	49.16	50.65	.19
Timothy in fall Red clover	20.0 10.0	1786	2038	955	830	1255	53.47	46.47	.06
Timothy in fall Red clover	40.0 10.0	1441	1961	819	622	1182	56.83	43.17	
Timothy in fall Red clover	80.0 10.0	1195	1893	771	423	1012	64.54	35.42	.04
Timothy in fall Timothy in spring Red clover	2.5 7.5 10.0	2788	2935	1116	1668	1508	40.02	59.83	.15

*The red clover on all the plots was seeded in the spring.
†The second crop in 1925 was chiefly clover.
‡Clear timothy hay was harvested in 1926.

Tables 3 and 4 both show that the yields of mixed timothy and clover, harvested in the first year in which the plots produced hay, decreased as the rate of sowing timothy in the fall increased. In the second season, when timothy hay only was harvested, the yields again decreased as the rate of sowing timothy increased. There are two explanations for this. Since there was a relatively small growth of clover where the timothy was sown at the higher

rates, there probably were smaller quantities of nitrates in the soil in the following year, than in plots where less timothy was sown and where the clover made a large growth. The second explanation is suggested by results obtained in another series of plots in which timothy but no clover was sown. In the second season in which these plots produced hay, the yields decreased as the rate of sowing increased. The decreased yields in the second season's timothy crop for the high rates of seeding, therefore, may be attributed to both the smaller growth of clover in the preceding year and the depressing effect of a too dense stand of timothy upon its own growth.

TABLE 4.—Yields of Air-dry Hay in 1927 and 1928, Plots Seeded in Fall of 1925 and Spring of 1926

Seeding	Seed per acre	Yield per acre				
		1927				1928
		First crop		Second crop	Total	Total
		Timothy	Clover			
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Timothy in fall. Red clover	1.25 10.0	1270	905	574	2187	2034
Timothy in fall. Red clover	2.5 10.0	1639	938	670	2581	2188
Timothy in fall. Red clover	5.0 10.0	1492	870	602	2363	1957
Timothy in fall. Red clover	10.0 10.0	1558	594	467	2153	1834
Timothy in fall. Red clover	20.0 10.0	1088	400	552	1500	1408
Timothy in fall. Red clover	40.0 10.0	826	274	519	1100	1277
Timothy in fall Red clover	80.0 10.0	802	263	460	1065	1201
Timothy in fall Timothy in spring Red clover	2.5 7.5 10.0	1384	767	490	2151	1765

*The second crop hay in 1927 was chiefly clover; the one crop in 1928 was clear timothy.

SOWING PART OF THE TIMOTHY IN THE FALL AND PART IN THE SPRING

In one set of plots 2.5 pounds of timothy seed was sown in the fall and 7.5 pounds with the clover in the spring. The yields of hay obtained from sowing the seed in this way compare very well with those obtained from any other method that has been tested.

Many farmers in the winter wheat area sow part of the timothy seed in the fall, largely because it has been their experience that there is less likelihood of failure to obtain a stand of plants than if the seed is all sown in the spring. In this experiment a relatively light rate of seeding in the fall produced a satisfactory meadow. Records obtained from farmers indicate that a large proportion of those who sow timothy with their fall grain, use more seed at that time than is needed. These experiments show that the yield of hay is thereby reduced and its quality injured by too dense a stand. It seems advisable to use no more, or even a little less, seed in the fall than is required for a satisfactory stand, and then, in the spring, to sow enough timothy with the clover to make up for any deficiency in the stand resulting from fall sowing.

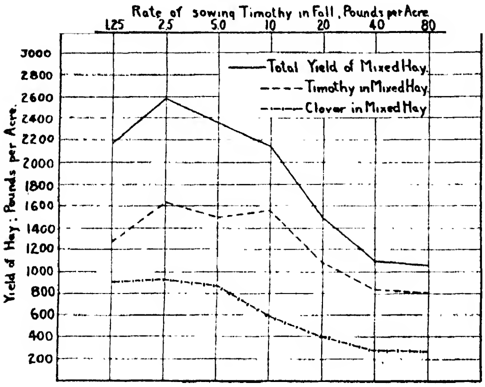

Fig. 2.—Effect of time and rate of sowing timothy on hay crop. Records obtained in 1927

If the meadow is to be maintained for only a single year in the rotation, the question may arise as to whether it is desirable to sow any timothy at all. In each one of the four series in which this experiment has been conducted, a larger yield in the first crop harvested was obtained from the plots in which 2.5 pounds of timothy was sown with the wheat and 7.5 pounds with the clover in the spring, than from the plots where no timothy was sown. In 1927, when the clover had been badly winter-killed, the yield of hay from the mixed timothy and clover was 70 percent higher than from clover alone.

SUMMARY

It has been found, as a result of experiments, that when 5, 10, or more pounds of timothy seed per acre are sown with winter wheat, and clover is sown in the spring, the yield of hay and the proportion of clover which it contains are smaller than if the timothy seed is sown in the spring—provided a satisfactory stand of plants is obtained from the spring sowing.

As the number of pounds per acre of timothy seed sown in the fall was gradually increased in fields of winter wheat in which clover was sown in the following spring, there was a gradual increase in the percentage of timothy in the first crop of mixed hay; a corresponding decrease in the percentage of clover; and a decrease in the yield. This decrease in the yield, as the rate of sowing increased, also occurred in the second season, in which the meadow produced a crop of clear timothy hay.

Satisfactory stands of timothy usually were obtained where the seed was sown at the rate of 2.5 pounds per acre. When the quantity was increased to 5 pounds per acre, there was a decrease in the proportion of clover and in the yield of hay. It seems advisable to sow not more than 2 or 3 pounds of timothy with the fall grain, then to add more timothy seed if needed when the clover is sown in the spring.

AN EASIER WAY TO KILL QUACK GRASS AND CANADA THISTLES

C. J. WILLARD[1]

Small patches of Canada thistles[2] and quack grass[3] can be killed by spraying with a solution of sodium chlorate more easily than by cultivation methods. Sodium chlorate is being extensively used in weed killing campaigns in several western states. Preliminary tests of this chemical in Ohio were made in 1928 at the Ohio State University, the Miami County Experiment Farm, the Mahoning County Experiment Farm, and the Northeastern Test Farm. Neither these tests nor the experiments in other states are sufficient to answer many of the questions about this method, but it is so simple and effective under some conditions that a preliminary report at this time seems justified.

What is sodium chlorate?—Sodium chlorate is a white salt which looks much like crushed rock salt. It has the great advantage over other chemical weed killers that it kills the root as well as the top of many of our worst weeds, while many other chemicals only kill the tops.

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[2]*Cirsium arvense* (L) Scop.
[3]*Agropyron repens* (L) Beauv.

Sodium chlorate does not sterilize the soil as many other chemicals do. Even after heavy sprayings crops can be grown within a year and sometimes within a month.

The material is not seriously poisonous to livestock, but may cause death. If much spraying is to be done in a pasture it would seem wise to keep stock off the pasture until after a heavy rain, or to fence off the areas sprayed. This is especially true if the cattle are hungry for salt.

Sodium chlorate is not unreasonably expensive, costing under normal conditions 8 to 9 cents a pound delivered to Ohio points. The extraordinary demand due to its use for weed killing has caused a runaway market recently, and prices can hardly be quoted.

How is sodium chlorate used?—Sodium chlorate is used as a solution in water, usually at the rate of one pound to a gallon of water. The dry material is easily dissolved by suspending it in a loose sack at the **top** of the required amount of water. It is sprayed on plants in any convenient way, so that all parts of the plant are thoroly wet with the solution. For large areas a potato sprayer or orchard sprayer is desirable. A knapsack sprayer or an ordinary sprinkling can may be used for small areas. The sprinkling can is somewhat wasteful of the solution.

In general, full bloom or just before bloom has been the most favorable stage for spraying most plants. The spray seems to be most effective when applied on a cloudy day and when the air is humid. However, spraying has been successful under all weather conditions except immediately before a rain. There is some indication that the spray is most effective when the soil is reasonably moist and the plants, therefore, actively growing, or at least not wilted. Particular pains should be taken to apply the spray thoroly and especially to the growing tips of the shoots. The best rate of application has not been worked out. For use on a large scale, the Kansas Station recommends 100 gallons to the acre. For the nearly complete eradication of small patches at one application, a much heavier rate than this is often necessary. Practically, with small areas, it seems desirable to use sufficient spray to thoroly wet all the plants.

For quack grass this requires 150 to 300 gallons per acre, or 1 to 2 gallons per square rod. Summer and fall sprayings of quack have been so effective that it is possible that the most practical time to start spraying quack is after an early hay crop is taken off. Plowing the land helps to locate the patches of quack, but whether it is desirable otherwise is not yet known. There should always be

a good top growth present for effective spraying. Altho one thoro spray has killed quack it is well to count on making at least three applications to finish this pest.

The best dates for spraying Canada thistles the first time seem to be June 15 to July 15. Summer and fall sprayings have also been very effective, but earlier than June 15 has been decidedly undesirable. Practically always some sprouts will appear after the first spraying, and these should be resprayed as soon as they have made a little growth. A third spraying may be necessary.

In preliminary tests last year a solution of a half pound to the gallon was quite effective on thistles, and it seems possible that using a solution of this strength liberally will prove more economical than using the stronger solution.

A demonstration at the Northeastern Test Farm illustrates the ideal condition under which to use sodium chlorate. Quack grass appeared in a field on this farm three or four years ago. It had formed a number of patches ranging in size from a few feet to a rod in diameter. Only a small proportion of the total area of the field was occupied by the pest, but it was firmly established, and its total possession of the field was only a question of time. The patches of quack in this field were heavily sprinkled with sodium chlorate solution on June 25. A few weeks later, as soon as any new growth started, the areas were sprayed again. The field was later plowed and sowed to wheat. Careful observations both last fall and this spring, failed to show any living quack in the field. The total cost, in materials and labor, of cleaning up this field was far less than it would have been by any other method, because no other method would have given such positive results in such a short time.

The cost of materials for such a cleanup will range from 30 to 60 cents a square rod. This is probably too expensive to clean up large areas of land but is cheap insurance when a few square rods threaten a whole field.

Sodium chlorate is the best means so far discovered for killing poison ivy. This almost universal roadside and fence line pest usually remains unmolested from year to year because few people can work in or with it without being poisoned. A heavy, thoro spraying, full strength, has repeatedly killed poison ivy at one application, and two, or at most, three sprayings have always finished the work when the first one did not.

Other weeds that have been successfully treated are bindweed ("peavine" or morning glory), ironweed, artichokes, horseradish,

burdock, spearmint, steelweed or frost-flower, goldenrod, and whitetop. Some other weeds have proved quite resistant. Horse nettle is an example. Agricultural crops are as readily killed by sodium chlorate as weeds.

CAUTION ! ! !

Sodium chlorate must be handled carefully.—It is a serious fire hazard. The material itself cannot be burned or exploded, but when it is mixed with or in contact with combustible material, such as sulfur, starch, wood, straw, cotton, or any other plant product, it makes an explosive if struck, or burns very rapidly if ignited. In fact, clothing, sacks, straw, barrels, or other materials which have been wet with sodium chlorate solution and then dried may take fire from simple friction, like a match, as well as from a heavy blow. For example, a wooden barrel, which had been used to make up sodium chlorate spray, burst into flame when hoops were being tightened on it after it had become extremely dry. One man suffered serious and painful burns on a hot dry day when a shoe which he had worn while spraying sometime before burst into flame as he was walking. Scratching a match on a pair of dry unwashed spraying overalls has also been responsible for painful burns. Potassium chlorate is an important ingredient of match heads, and sodium chlorate could be used in the same way.

We can deal with sodium chlorate better if we understand exactly what it does. Most of us have watched a garage man burn the carbon out of automobile cylinders, feeding oxygen from a tank into the cylinders to make the carbon burn as it would not in the dilute oxygen furnished by the air. Chemically, sodium chlorate is practically a tank of oxygen in solid form. It furnishes oxygen to any burnable material just as quickly as the tank does. Throw a pinch of sodium chlorate on a fire and at once you get the same flashing, sparkling, extremely rapid burning that we see in the auto cylinder. On the other hand if you hold a lump of sodium chlorate above a blue gas flame, there is no unburned fuel for it to combine with, and it will simply melt. Again, this is like the auto cylinder after the carbon is burned out, which you could feed oxygen into indefinitely without getting any fire.

Some concern has been caused among users of sodium chlorate by the sticker, "Do not drop", frequently found on drums of the material. In the freight tariffs sodium chlorate is classified as an explosive and this "yellow label" sticker, saying "Explosive—do not drop", is put on all such shipments, just as "Glass" is put on many shipments which are classed as fragile, tho there may not be a

particle of glass in them. A drum of it as received can be handled with impunity, but if a little sulfur, sugar, starch, or any other finely divided burnable substance is mixed with it, and the mixture struck, it will cause a dangerous explosion. In farm use, sodium chlorate is more dangerous as a fire hazard than as an explosive. The following precautions will insure safety in handling the material:—

FOLLOW THESE PRECAUTIONS !

1. Use metal or earthenware containers for sodium chlorate solution if possible. If necessary to use wooden containers or spray tanks wash them out thoroly after using and then let them stand full of pure water for several days or weeks before emptying. As far as possible, keep them moist thereafter.

2. Wear rubber boots when spraying. Shoes once soaked with the solution are difficult, almost impossible, to free from it.

3. Wash thoroly or destroy all clothing, sacks, or other cloths which have become soaked with the solution. Usually it is possible to conduct the spraying in such a way as to keep the solution off one's clothes, but it should never be allowed to dry on them.

4. Avoid spilling the dry salt or the solution on floors, walls, wagon beds, etc. Keeping equipment well painted reduces the danger from absorbing the solution.

5. Do not use matches around spray clothing that has dried out. To do this is rather less safe than striking a match to see how much gasoline is in the tank.

6. Always store sodium chlorate in tight metal or glass containers, not in cloth or paper sacks. Sodium chlorate takes up water in damp weather, so much that it may dissolve completely. Sacks and floors under them rapidly become dangerous fire hazards from absorbing the dissolved chlorate and then drying again.

7. Keep sodium chlorate containers tightly covered to keep out all foreign material which might make an explosive mixture. Sulfur in any form is especially dangerous and should not be stored in the same room with sodium chlorate.

8. Keep sodium chlorate away from children as you would any other dangerous material.

Other chlorates as weed killers.—Preliminary tests at the Kansas Agricultural Experiment Station with two other chlorates, calcium chlorate and magnesium chlorate, suggest that they may be as effective as sodium chlorate as weed killers, or possibly more effective. They have the great advantage over sodium chlorate of being less of a fire hazard. Calcium chlorate is now on the market in a patented preparation.

RETURNS PER ACRE IN CATTLE FEEDING MADISON COUNTY EXPERIMENT FARM

PAUL GERLAUGH AND H. W. ROGERS

Is the profit per steer basis of figuring cattle feeding returns the correct one for cattle feeders to follow?

Is it true that cattle that make the most rapid gains, and sell for the high dollar on the market, are more profitable than cattle that make less rapid gains and sell at a more conservative figure when they reach the market?

These two questions deal with fundamentals in cattle feeding. In order to obtain information along these lines, two lots of yearling steers were fed at the Madison County Experiment Farm during the past winter and spring.

An area of 6½ acres of corn was put into a silo to provide the major portion of the ration for one lot of 14 head. A similar 6½ acres, obtained by alternating twelve-row strips thru the field, was placed in the shock and later husked and cribbed. The corn, chopped for five weeks and then shelled, was fed to ten head of similar weight cattle.

Two pounds of cottonseed meal was fed daily to each steer in both lots. Mixed hay was also fed to each lot and stover to the corn-fed lot.

The cattle started the test November 21 and were soon on a full ration of their respective feeds. The 6½ acres of corn that had been put into the crib yielded 312 bushels of corn. We assumed that there was an equal amount in the silo, due to the method of harvesting. March 11 found the crib empty, but considerable silage on hand. It was decided to weigh up the cattle, have them valued, and continue the corn fed lot on the same ration until the silage fed cattle finished their assignment.

On March 11 the corn-fed lot of cattle weighed 870 pounds, and the cattle in the silage-fed lot averaged 864 pounds. This was at the end of 110 days on test, and showed an average daily gain of 2.20 pounds for Lot 1, silage fed, and 2.39 pounds for Lot 2, corn fed. Appraisals of $12.25 per cwt. for Lot 1, and $13.00 per cwt. for Lot 2, were placed on the cattle on that date. These appraisals were on the basis of Cleveland, Cincinnati, and Pittsburgh markets rather than net values in the feed lot.

On May 14 the silage from the 6½ acres of corn was exhausted. The cattle and hogs were weighed and the results computed, as shown in the accompanying table. During the 174-day feeding period Lot 1 consumed the silage from 6½ acres of corn while Lot 2 consumed the corn from 10½ acres.

TABLE 1.—Summary, Cattle Feeding Test 1928-29

Yearling steers fed 174 days Nov. 21 to May 14	Lot 1 Corn silage Cottonseed meal Mixed hay	Lot 2 Shelled corn Corn stover Cottonseed meal Mixed hay
Number of steers per lot	14	10
Average weight, November 21, pounds	622	607
Average weight, May 14, pounds	971	998
Average daily ration		
Shelled corn, pounds	....	16.3
Corn stover, pounds	....	9.5
Corn silage, pounds	47.4	....
Cottonseed meal, pounds	2.0	2.0
Mixed hay, pounds	1.2	1.6
Average daily gain, pounds	2.01	2.24
Steer days fed per acre of corn	375	166
Beef per acre of corn fed, pounds	752	372
Pork per acre of corn fed, pounds	39	67
Total beef and pork per acre of corn fed, pounds	791	439
Feed required for 100 pounds gain		
Shelled corn, pounds	....	727
Corn stover, pounds	....	424
Corn silage, pounds	2370	....
Cottonseed meal, pounds	100	89
Mixed hay, pounds	60	71
Cost of 100 pounds gain	$10.22	$15.75
Profit per steer (pork included)	$ 8.58	$ 3.46
Returns per acre of corn fed (pork included)	$71.65	$50.80
Yields per acre		
Silage, tons	8.8	....
Grain, bushels	....	48
Market appraisal, Pittsburgh basis	$14.00	$14.75
Cost of cattle at farm	$13.50	$13.50
Estimated marketing expense	$ 1.00	$ 0.80
Marketing and killing data		
Weight at farm June 4, pounds	1035	1065
Selling weight Dayton June 7, pounds	971	1003
Selling price Dayton June 7	$14.50	$15.15
Dressing percentage	59.6	60.6
Cost of beef on the rails	$23.66	$24.23

FEED PRICES

Shelled corn	$0.90 per bu.	Mixed hay	$15.00 per ton
Corn stover	5.00 per ton	Cottonseed	55.00 per ton
Corn silage	6.00 per ton	Hogs	11.00 per cwt.

An acre of corn in the form of silage gave us more than twice as many steer-day rations. However, we received less gain per day from the silage fed cattle. As would be expected there was considerably less pork credit in the lot fed silage, as compared with the corn-fed cattle. Most feeders feel that their cattle feeding operation is one involving the hogs following the cattle, and we have so figured the results.

An acre of corn fed as silage returned 791 pounds of gain on the cattle and pigs following them, while an acre of similar corn, fed as shelled corn and stover, gave 439 pounds of gain on cattle

and hogs. A hundred pounds of gain on the cattle in the corn-fed lot was worth $2.55 more than each hundred pounds of gain in the silage-fed lot. This was due to the higher market value of the corn-fed lot at the close of the test.

Fig. 1.—Rear portion of sides of corn-fed cattle

After the test closed the cattle were held three weeks on similar rations, in order that they might be exhibited at the Dayton Livestock Show. On June 4 the cattle in Lot 1 weighed 1,035 pounds and those in Lot 2, 1,065 pounds. They were trucked to Dayton and sold there June 7. Lot 1 sold for $14.50 per cwt. and weighed 971 pounds. Lot 2 sold for $15.15 per cwt. and weighed 1,003 pounds. Both lots were held off feed and water, which accounts for the heavy shrink. The Hughes Provision Company of Cleveland purchased both lots. They were slaughtered June 10. Lot 1 dressed 59.6 percent and Lot 2 60.6 percent. The carcasses of the Lot-2 cattle, on the average, showed a little more covering of fat. The fattest carcass of the twenty-four was in the silage-fed lot. Mr. Wm. Hughes stated that both lots of cattle killed very satisfactorily, and probably would go to the trade at the same price per pound.

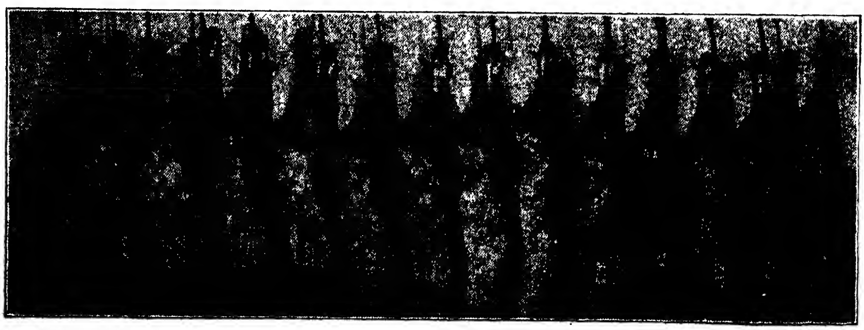


Fig. 2.—Rear portion of sides of silage-fed cattle

In spite of the fact that the steers in Lot 2 made the most rapid gains, had more gain from pigs following them, and obtained a higher market valuation, they were less profitable than the steers in Lot 1. The cost of feeding them was much more expensive and was responsible for this difference.

An acre of corn fed as silage returned $71.65, while a similar acre of corn fed as grain and stover returned $50.80.

Fig. 3.—Side from fattest silage-fed steer, left; from fattest corn-fed steer, right

GLADIOLUS VARIETIES

W. W. WIGGIN

The gladiolus is one of the more important flower crops in Ohio. Many home gardeners grow gladioli because of their ease of culture, and excellent cutting qualities. Commercial plantations are also abundant, where corms and cut flowers are grown on a large scale.

A great deal of interest is shown in the discussion of varieties. A person reading the catalogs, and having had no experience with the multitude of varieties described, would be at a loss in making selections. Therefore, an impartial description of the varieties grown at Wooster during the season of 1928 may be of interest.

Fig. 1.—General view of a section of the gladiolus planting

Gladiolus catalogs give accurate descriptions, it is true, but many persons make the mistake of judging the value of a variety by the price charged for the corms. On a commercial scale it is generally agreed that the newer, high priced introductions, are the paying varieties to grow. They continue to be paying varieties up until there are enough corms available so that the price is reduced. Again varieties that do not multiply rapidly, such as War and

Herada, are generally higher priced than more vigorous varieties, such as Peace and Schwaben. Where cut flowers are grown commercially, small flowers of only ordinary quality are so abundant that during the height of the season they are a drug on the market. At the same time flowers that have extremely high quality, and unusual appearance, will sell, even tho the return is not large. These points hold the prices of certain varieties at a higher level. Growers who contemplate having just enough for their own cutting needs and for the effect around their grounds, can often find varieties of great merit among the lower priced corms.

Fig. 2.—Showing varietal differences in spike growth

An attempt has been made to give the reader some idea of the color. Few people looking at a variety will describe it in the same way, hence the descriptions given in catalogs for the same variety may differ widely. The colors of a variety grown on a heavy soil are of deeper shade than those of the same variety grown on a lighter soil.

The leaves of the gladioli show a wide variation in shade, abundance, and resistance to disease. Dark green, abundant, disease resistant foliage is preferable.

The stems should be sufficiently rigid to support the flowers properly, straight but still not too stiff. A fair length is desirable.

The flowers should be of a firm texture, several opening at one time, holding up well, and well arranged on a good spike.

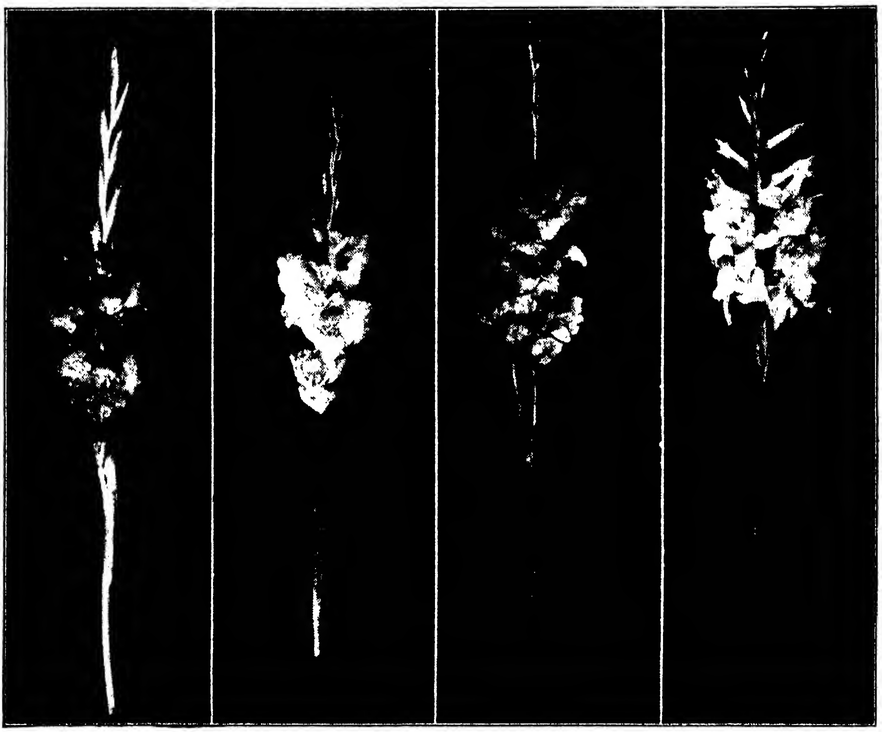


Fig. 3.—Left to right—A ruffled petaled variety; a small delicate spike excellent for floral decoration; a very large spike; petals arranged poorly on spike

In the descriptions the date they first blossomed at Wooster, when planted May 28, is given.

The remarks contain our impression of the value of the variety for general purposes. Personal likes, of course, enter into these impressions. Such novelties as Helen Howard did not appeal to the writer, but they might greatly impress another individual.

Some of the 51 varieties described herein are old standards, some are new introductions, and one, Loyalty, was not on the market in 1928.

Alice Tiplady.—Color orange saffron; leaves dark green, moderately abundant, healthy; stems good, 42 inches; flowers fair, a bit scattered, but on good spikes, number 12 to 14. Remarks: Good to medium, date August 15.

Altair.—Color salmon saffron; leaves medium to light green, moderately abundant, slightly diseased; stems slender, but stand up well, 50 inches; flowers lower ones too far apart, but top well arranged, number 17. Remarks: Good color and nice flower, date August 4.

America.—Color flesh pink; leaves dark green, moderately abundant, healthy; stems good, 38 inches; flowers good on good spike, number 17. Remarks: Good, pale pink, date August 18.

Anna Eberius.—Color velvety purple, deep purple throat; leaves medium green, moderately abundant, some diseased; stems good, 42 inches; flowers well arranged on good spike, number 12. Remarks: Very good purple, date August 18.

Betty Bales.—Color near true blue; leaves dark green, scarce, healthy; stems poor, crooked, 39 inches; flowers divided on fair spike, number 16. Remarks: A blotched purple, date August 18.

Carmen Sylva.—Color white; leaves medium green, scarce, healthy; stems good, 46 inches; flowers well arranged on good spike, number 16. Remarks: Good white, but some pink splotches, date August 18.

Catherine Coleman.—Color clear salmon pink, rose colored feathering deep in throat; leaves medium green, moderately abundant, healthy; stems good, medium strength, 56 inches; flowers well arranged on excellent spike, number 21. Remarks: Most promising new salmon pink, date August 10.

Crimson Glow.—Color scarlet; leaves dark green, moderately abundant to abundant, healthy; stems medium to good, 48 inches; flowers fair to good on good spike, number 16. Remarks: Good bright red, date August 10.

Dr. F. E. Bennett.—Color brilliant flaming orange; leaves dark green, moderately abundant to abundant, healthy; stems good, a bit too coarse, 42 inches; flowers well arranged on good spike, number 16. Remarks: Fair bright red, date August 10.

Elizabeth Tabor.—Color rosy pink on white ground, crimson blotch; leaves light green, moderately abundant, healthy; stems tall, weak, 48 inches; flowers too far apart on stem and over too large area, number 15. Remarks: Earliest variety, good shade of pink, date July 20.

Elora.—Color Creamy white overlaid with pink; leaves medium green, moderately abundant, healthy; stems tall, erect, excellent; flowers well arranged on excellent spike, number 15. Remarks: Early white, excellent, date August 2.

Evelyn Kirtland.—Color luminous coral-pink, darker edges; leaves medium to dark green, moderately abundant, some diseased; stems good, 48 inches; flowers good, on good spike, number 18. Remarks: Very good, date August 18.

Giant Nymph.—Color light rose-pink; leaves medium green, abundant, healthy; stems excellent, tall, 48 inches; flowers well arranged on excellent spike, number 17. Remarks: Very good, date August 4.

Gold.—Color pure yellow; leaves good green, moderately abundant to abundant, healthy; stems good, 38 inches; flowers well arranged on good spike,

number 16. Remarks: Good yellow, but fades when flowers open, date August 7.

Gold Eagle.—Color deep pure yellow; leaves medium dark green, abundant, healthy; stems tall, strong, 42 inches; flowers well arranged, compact, on good spike that blossoms to tip 8 or 9 in bloom at once, number 15. Remarks: Earliest yellow, date July 20.

Golden Glory.—Color yellow; leaves dark green, scarce, healthy; stems fairly good, a bit heavy; flowers a bit close on heavy spike, ruffled, number 16. Remarks: Good, date August 10.

Golden Swallow.—Color yellow; leaves dark, abundant, healthy; stems medium to good, 38 inches; flowers good on stem of good proportion, number 13. Remarks: An early yellow, date July 25.

Helen Howard.—Color buff flushed coral, dashed with peach-red, throat purest amber; leaves dark green, abundant, healthy; stems tall, strong, 42 inches; flowers well arranged on good spike, number 14. Remarks: Early, unusual color, date July 27.

Herada.—Color mauve; leaves dark green, moderately abundant to scarce, susceptible to disease; stems good, 36 inches; flowers good on good spike, number 11 to 12. Remarks: Good for color, date August 18.

Illuminator.—Color brilliant carmine red, French blue blotches; leaves medium light color, moderately abundant to few, healthy; stems medium height, good, 34 inches; flowers well arranged on good spike, number 14. Remarks: Good, date August 10.

Jack London.—Color light salmon with vermillion stripes; leaves medium green, moderately abundant; stems medium height, good; flowers good on good spike, number 18. Remarks: Good pale salmon pink, date August 10.

Joe Coleman.—Color rich red; leaves medium green, moderately abundant to few, a bit diseased; stems good, erect, 40 inches; flowers excellently arranged on excellent spike, ruffled, number 15. Remarks: Good, date August 7.

Kunderdi Glory.—Color creamy apricot, light tint of pink and red on lower petals; leaves medium green, abundant, healthy; stems good, 44 inches; flowers well arranged on excellent spike, number 15. Remarks: Good, date August 18.

Lacinatus.—Color rose pink; leaves medium green, few, slender, healthy; stems medium, erect, 30 inches; flowers poor, on very short spike, pointed, wavy petals, number 3. Remarks: Poor, date August 7.

Los Angeles.—Color orange pink, deeper throat blotch; leaves dark green, very abundant, healthy; stems long and stiff, 52 inches; flowers well arranged on excellent long spike, number 19. Remarks: Excellent, date August 7.

Louise.—Color bluish lavender, wine colored blotch on lower petals; leaves medium green, moderately abundant, healthy; stems short, strong, 38 inches; flowers a bit close on good spike, number 14. Remarks: Good color, date August 18.

Loyalty.—Color pure deep yellow; leaves very dark green, very abundant, very healthy; stems good, strong; flowers fairly well arranged on excellent spike, number 20. Remarks: Purest yellow, the color does not fade, excellent, date August 7.

Magic.—Color lavender-blue with large rich purple throat blotches; leaves medium green foliage, inclined to be scarce, healthy; stems tall, erect, 46 inches; flowers scattered on heavy spike, number 17. Remarks: Fair, date July 27.

Mona Lisa.—Color palest rose-pink or blushed white; leaves medium to dark green, scarce, healthy; stems good, 38 inches; flowers inclined to circular on good spike, number 16. Remarks: Fair pale pink, date August 18.

Mrs. Dr. Norton.—Color pale pink, with primrose center, yellow blotch on lower petals; leaves medium green, moderately abundant, considerably diseased; stems medium height to tall, good, 48 inches; flowers scattered, good stem, number 20. Remarks: Excellent color, date July 30.

Mrs. F. C. Peters.—Color rose lilac, crimson blotch; leaves dark green, moderately abundant, healthy; stems fair to good, 42 inches; flowers circular on good spike, number 16. Remarks: Very good color, date August 18.

Mrs. Leon Douglas.—Color bright begonia rose, striped with orange and brilliant scarlet; leaves medium to dark green, moderately abundant to abundant, healthy; stems medium to fair, some crooked, 52 inches; flowers circular on excellent spike, number 16. Remarks: Good color, date August 10.

Myra.—Color deep salmon over yellow ground, yellow throat with pink lines; leaves dark green, moderately abundant; stems medium length, weak; flowers scattered, few on short spike, number 12. Remarks: Good, date July 30.

Niagara.—Color cream, carmine markings on throat; leaves dark green, abundant, healthy; stems good, 52 inches; flowers inclined circular on stiff spike, number 15. Remarks: Good, date August 18.

1 0 1 Blue.—Color upper petals clear blue, shading lighter at base, lower petals darker blue with purplish crimson blotch; leaves light green, abundant, healthy; stems moderate, inclined to be weak; flowers well arranged, good length, number 14. Remarks: Earliest blue, date July 22.

Orange Glory.—Color orange, lighter throat; leaves medium green, abundant, healthy; stems good, inclined to be stiff, 40 inches; flowers well arranged, close on good spike, number 18. Remarks: A good orange, date August 18.

Panama.—Color clear pink; leaves medium green, moderately abundant to scarce, healthy; stems good; flowers fairly good, on good spike, a bit too open to be real good, number 16. Remarks: Fair, date August 20.

Peace.—Color white with pale lilac feathering on lower petals; leaves dark green, abundant, very healthy; stems excellent, tall, a bit stiff, 56 inches; flowers fairly well arranged on good spike, a bit spreading, number 18. Remarks: Good, very vigorous, healthy grower, date August 22.

Princess.—Color scarlet, white throat; leaves medium green, scarce, healthy; stems medium to good, 42 inches; flowers well arranged on good spike, number 16. Remarks: Poor, date August 18.

Purple Glory.—Color deep purplish maroon; leaves medium green, abundant, healthy; stems good, 52 inches; flowers good on good spike, number 16. Remarks: Good, date August 10.

Remembrance.—Color deep salmon pink; leaves medium green, moderately abundant to abundant, healthy; stem good, 48 inches; flowers good, but a bit scattered, on good spike, number 15. Remarks: Fair, date August 18.

Richard Diener.—Color pure salmon rose; leaves dark green, medium abundant, a bit diseased; stems good, 38 inches; flowers a bit circular on good spike, number 15. Remarks: Fair, date August 18.

Rosemary.—Color white, thickly marked with parallel hairlines of lavender rose; leaves medium to light green, moderately abundant to scarce, healthy; stems short, slender, but erect, 40 inches; flowers inclined to be too far apart on good spike, number 12 to 13. Remarks: Very unusual, date August 10.

Schwaben.—Color pale yellow, distinct crimson blotch in throat; leaves dark green in color, abundant, healthy; stems good, 44 inches; flowers good on good spike, a bit stiff, number 18. Remarks: A good pale yellow, date August 18.

Sheila.—Color salmon; leaves dark green, moderately abundant, healthy; stems medium length, weak, 42 inches; flowers inclined to be poorly arranged on poor spike, number 15. Remarks: Poor, date August 2.

Sulphur Glow.—Color sulphur yellow; leaves dark green, moderately abundant, healthy; stems very short and stiff, 36 inches; flowers ruffled, rather compact, on good spike, number 19. Remarks: Only few flowers open at time and hold up poorly, date August 10.

Tycko Zang.—Color clear salmon pink; leaves good, dark green, abundant, healthy; stems medium quality, very stiff and erect, 40 inches; flowers excellent on good spike, number 19. Remarks: Very good, date August 7.

Tyrian Beauty.—Color American beauty rose color; leaves dark green, moderately abundant, healthy; stems good, 50 inches; flowers good on good spike, number 15. Remarks: Fair to good, date August 10.

White Wonder.—Color pure white, without any markings; leaves medium green, moderately abundant, some disease; stems good, 40 inches; flowers well arranged on good spike, number 15. Remarks: A fair to good white, date August 18.

Wilbrink.—Color flesh pink, creamy blotch on lower petals; leaves medium light, drooping foliage, healthy; stems tall, inclined to be weak, 42 inches; flowers fairly well arranged on good spike, number 13. Remarks: Early, date July 25.

Yellow Treasure.—Color deep yellow, touch of cerise deep in throat; leaves dark green, abundant, healthy; stems medium to good, 46 inches; flowers fair to good, on good spike, number 12 to 14. Remarks: A good yellow, does not fade, date August 10.

TREND IN PRICES OF FARM PRODUCTS, CASH RENT, AND FARM REAL ESTATE IN OHIO

R. L. MOORE

Farm real estate prices tend to react to important changes in the price level of farm products. However, the relative positions of land prices and farm products prices may be materially changed over a period of years. This has been well demonstrated in Ohio agriculture the past fifty years. Prior to 1900 land prices were relatively low in comparison with the prices of farm products, when the 1913 level of each is considered as normal. About the year 1900 land prices began to rise and the trend upward was at a faster rate than the rise in prices of farm products. This tendency continued until the stimulation of war demand in 1916 pushed the price of farm products up much faster than the price of land.

This tendency of farm products prices to rise and land prices to lag behind continued until 1920, the beginning of the deflation period. Since then land prices have continued to fall until near the 1912 level was reached in 1928. On the other hand, prices of farm products recovered, and have maintained some stability for the last four years around 150 percent of the pre-war level. There is reason to believe that increased costs of production would lead to a present price of land below 150 percent of the pre-war level. That is, a little lower than the current price level of farm products.

Cash rent may be considered a measure of the gross annual income to be derived from the investment in farm land. Column 3 in Table 1 shows the relative cash rental values of Ohio farms from 1900 to 1928. The trend of cash rents has not conformed so very closely to the trend of farm land prices. Changes in rents have been definitely slower than changes in land prices. This lag has had an important bearing on the rate of annual income possible from the investment in land let for cash. This point may be illustrated by columns 2, 3, and 4 in the table. The annual return on an investment in farm land made in 1900, when land was 54 percent of the 1913 price, would yield 83 percent of the 1913 cash rent. This income would be 54 percent higher than the annual income on the investment in land bought in 1913, and 70 percent higher than the annual income on the investment in land bought in 1920. Since 1920 the trend of gross annual income, that is, cash rent, has been upward when measured by the current land prices of each

TABLE 1.—Relative Prices, Ohio: Farm Products and Farm Real Estate, 1877 to 1928; Cash Rent Per Acre and Cash Rent in Terms of Farm Real Estate Prices, 1900 to 1928

(1913=100)

Year	Ohio farm products prices	Ohio farm real estate	Cash rent	Cash rent in terms of real estate prices
1877	73	58		
1878	70	61		
1879	80	56		
1880	93	57		
1881	100	64		
1882	87	65		
1883	84	68		
1884	74	68		
1885	68	68		
1886	73	64		
1887	81	70		
1888	71	67		
1889	67	66		
1890	77	60		
1891	74	59		
1892	74	58		
1893	76	60		
1894	66	56		
1895	64	56		
1896	55	53		
1897	58	51		
1898	63	51		
1899	64	51		
1900	71	54	83	154
1901	72	60	86	126
1902	79	63	86	136
1903	76	62	86	138
1904	75	69	86	125
1905	79	72	88	122
1906	82	76	89	117
1907	90	83	91	110
1908	90	82	91	111
1909	98	87	92	106
1910	99	93	96	103
1911	90	101	98	97
1912	106	98	99	101
1913	100	100	100	100
1914	101	102	103	101
1915	102	107	106	99
1916	116	113	108	96
1917	175	119	112	94
1918	195	131	122	93
1919	210	135	127	94
1920	204	159	134	84
1921	127	134	181	135
1922	122	124	142	115
1923	129	122	143	117
1924	128	118	140	119
1925	153	110	132	120
1926	149	105	133	127
1927	141	99	134	135
1928	148	96	135	141

year (Column 4). The data indicate that 1928 land prices and cash rents were in a position relatively similar to that which existed in the year 1900. At both times prices of farm products and cash rents were relatively high as compared with the price of land.

The relative prices given in the table of farm products from 1877 to 1912 were derived from the wholesale price of farm products on the Cincinnati market; from 1913 to 1928 the index of farm products prices as published currently in the Bimonthly Bulletin were used with the 1913 prices considered as 100. Data on cash rents were collected by the Bureau of Agricultural Economics, United States Department of Agriculture.

Farm real estate prices, 1877 to 1912, were based on the values named in deeds for agricultural lands, as reported to the Secretary of State. From 1913 to 1928 the index of farm real estate published currently in the Bimonthly Bulletin was used.

APPLE SALES OF AN OHIO ORCHARD COMPANY IN 1928

CHAS. W. HAUCK

An analysis of the sales of the 1928 apple crop of an orchard company in eastern Ohio, has just been completed. The price, grade, quantity, variety, date, and type of buyer were recorded for each individual sale thruout the season. The total sales aggregated 9,067 bushels, 52 percent of which was Fancy, 22 percent B Grade, 15 percent Drops, and 11 percent Culls and Ciders.

Jobbers provided the main sales outlet, buying two-thirds of the crop. About 1/6 or, 16 percent, of the fruit was sold in the forms of fresh fruit and cider thru the roadside market maintained by this orchard company, and about 10 percent additional was sold from the orchard direct to consumers, or a total of about one-fourth of the crop was sold to consumers. Retailers took the remainder, about 7 percent, made up of 455 bushels to individual retailers and 145 to chain stores. The latter constituted only a minor sales outlet.

Jobbers preferred the better grades of apples. Fancy fruit constituted 65 percent of their purchases and B grade 28 percent, the two better grades thus comprising 93 percent of the fruit taken by jobbers. Obviously jobbers were not interested in the inferior

fruit—drops, culls, and ciders—a fact which carries great significance when it is recalled that two-thirds of the total sales were made to jobbers.

Consumers who bought at the orchard or roadside stand were not so exacting. They took more drops, culls, and ciders than Fancy and B grade apples. These low grades made up 55 percent of the fruit bought at the fruit stand and 80 percent of that bought by consumers at the orchard. Here is evidence that the orchardist located on good roads, accessible to consumers, has a valuable outlet for lower grades which remain after sorting. In this connection it should be noted that the crop studied was well grown and carefully sorted, and that even the lower grades contained no seriously defective apples.

TABLE 1.—Apple Sales of One Ohio Orchard Company in 1928

Variety	Sold	Value	Weighted average price per bushel	Prices to jobbers fancy grade per bu.
	Bu.			
Delicious	442	$ 848.70	$1.92	$2.29
Rome Beauty	959	1,541.20	1.61	2.00
Jonathan	2,705	3,917.20	1.45	1.68
Grimes Golden	3,715	5,120.00	1.39	1.40
Yellow Transparent	1,245	1,558.34	1.26	1.40
Total	9,067	12,985.44	1.43	1.57

Buyers	Bought	
	Bu.	*Pct.*
Jobbers	6,144	67.77
Retailers (Indv.)	455	5.02
Retailers (Chain)	145	1.59
Consumer	2,323	15.62
Total	9,067	100.00

The analysis shows that 85 percent of the apples sold to individual retailers were drops, culls, and ciders, but only 10 percent of the sales to chain store retailers were of this low quality. This 10 percent was made up entirely of drops; chain stores bought no culls and ciders. Chain retailers favored B grade apples; almost 85 percent of their purchases were of this quality. It is clear that the chain stores, tho using very few Fancy apples, handled a better quality of fruit from this orchard than did the individual retailers.

Popularity of the several varieties of apples, measured in terms of the average price per bushel paid by jobbers for the Fancy grade, ranked in the following order: Delicious, Rome Beauty,

Jonathan, Grimes Golden, and Yellow Transparent. Delicious averaged $2.29 per bushel, Rome Beauty $2.00, Jonathan $1.68, Grimes Golden $1.40, and Yellow Transparent $1.40.

The weighted average price per bushel of each variety, in which sales of all grades and sales to all buyers are included, followed the same order as above. The influence of the lower prices paid for grades other than Fancy and the influence of the higher prices paid by buyers other than jobbers are both reflected in the weighted average prices, which were as follows: Delicious $1.92 per bushel, Rome Beauty $1.61, Jonathan $1.45, Grimes Golden $1.39, and Yellow Transparent $1.25.

Prices paid by the various classes of buyers for a given grade and variety are exemplified by the prices at which Grimes Golden fancy were sold. This grade brought the following average prices for the season: Consumers $2.02 per bushel, individual retailers $1.87, fruit stand $1.80, chain retailers $1.44, and jobbers $1.40. As might be expected from the relative quantities purchased, consumers paid the highest price for practically every grade and variety, and jobbers paid the least. Not enough direct comparisons were possible between chain and individual retailers to determine which of these paid the more.

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

Farm income during the first four months of the year 1929 was higher than that for the corresponding months of 1928. This improvement in income was largely due to better prices. During April, however, larger marketing of hogs helped to bring up the income. Farm wages during April were somewhat lower than one year ago. It is of interest to note that since 1921 there has been much less fluctuation in the prices paid by farmers for commodities purchased than there has in farm prices or in the amount received from farm sales.

Trend of Prices and Wages, 1910-1914=100

	Wholesale prices all commodities U. S.	Weekly earnings N. Y. state factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm products prices	Ohio cash income from sales†
1913	102	...	100	100	104	100	105	104
1914	100	100	101	102	102	102	105	109
1915	103	101	106	100	103	107	106	109
1916	130	114	123	117	113	113	121	119
1917	181	129	150	176	140	119	182	191
1918	198	160	178	200	175	131	203	242
1919	210	185	205	209	204	135	218	268
1920	230	122	206	205	236	159	212	225
1921	150	203	156	116	164	134	132	129
1922	152	197	152	125	145	124	127	127
1923	156	214	153	135	166	122	134	137
1924	152	218	154	134	165	118	133	139
1925	161	223	159	146	165	110	159	147
1926	154	229	156	136	170	105	155	156
1927	149	231	154	131	173	99	147	144
1928	153	232	156	139	169	96	153	134
1927								
January	150	232	...	126	172	...	145	...
March	148	234	154	126	...	99	144	...
July	147	228	...	130	174	...	147	...
August	149	231	...	132	...	...	149	...
September	152	233	154	140	...	...	149	...
October	152	231	...	139	175	...	150	...
November	152	226	...	137	...	...	149	...
December	152	233	153	137	...	...	145	...
1928								
January	151	230	...	137	158	...	141	139
February	151	230	...	135	...	...	141	127
March	150	233	155	137	...	...	145	126
April	152	227	...	140	172	96	152	127
May	154	230	...	148	...	...	167	135
June	153	232	157	145	...	...	163	142
July	154	230	...	145	173	...	162	132
August	155	231	...	139	...	...	158	119
September	157	234	156	141	...	...	158	121
October	153	234	...	137	174	...	153	139
November	151	233	...	134	...	...	146	151
December	151	237	...	134	...	...	147	151
1929								
January	152	234	156	133	166	...	144	141
February	151	236	156	136	...	...	149	133
March	153	239	156	140	...	94	153	134
April	...	...	...	...	163	...	150	138

NEW MONOGRAPH BULLETINS

No. 427, A Business Study of the Ohio Poultry Producers' Cooperative Association, L. G. Foster. The information deals with the market outlets for the various grades of eggs and poultry and the prices received and should be of especial interest to the poultry producers of the State.

No. 428, The Ox Warble Flies, Don C. Mote. Cattle in Ohio are subject to attack by two species of warble flies. These are described and control measures suggested.

No. 429, The European Corn Borer and Its Environment, L. L. Huber, C. R. Neiswander, and R. M. Salter. This technical bulletin of 196 pages gives the results to date of a broad biological study of the insect and its environment by a score of scientists. The work centers, first, around the insect itself; second, its environment (of which the corn plant, the chief host of the insect, temperature, moisture, and light are some of the chief components); and, third, the economic application to farming practices of the principles involved.

No. 430, The Normal Sprouting of Seed Potatoes, John Bushnell. The sprouting at different planting dates and factors affecting the character of sprouting, such as storage temperature and ventilation, light, maturity, size of seed piece, and soil temperature are discussed.

No. 431, The Forty-Seventh Annual Report, C. G. Williams. In this bulletin of 180 pages, the Director reports briefly "the work of the past year, together with such results as are ready for publication and have a practical bearing on Ohio agriculture in its largest sense."

No. 432, Ohio Potato Diseases, Paul E. Tilford. More than a score of the potato diseases most serious in Ohio are described and practices that lead to their prevention and treatments for their control are given.

No. 433, Food Consumption of Farm Families, Hughina McKay. The food consumption of 47 rural families were studied in two ways: A, the adequacy of the diet of individual families, and B, the food habits of the group as shown by the quantity and adequacy of the foodstuffs used.

No. 434, Fruit Varieties in Ohio, IV, Crab Apples, C. W. Ellenwood. A brief discussion of the value and culture of the crab apple is followed by descriptions of 18 varieties.

No. 435, What Does It Cost to Grow a Bushel of Apples? F. H. Ballou. All the items of expense in the production of apples in a central Ohio orchard during a period of five years are presented and analyzed.

No. 436, The Nutritive Value of Blood Meal for Growth, A. R. Winter. This bulletin is the result of a study—research and experimental—of the biological value of blood-meal proteins for growth and was presented as a requirement for the degree of doctor of philosophy in the Ohio State University.

No. 437, Keeping Chickens in Confinement, D. C. Kennard and R. M. Bethke. How chickens may be kept in confinement and advantages and disadvantages of the practice are discussed.

FIELD DAYS AT THE EXPERIMENT STATION

Livestock Days, Wooster, April 19; Kenton, April 22; Columbus, April 24; and Cincinnati, April 26.
Lawn Day, Saturday, June 8.
Poultry Days, Thursday and Friday, June 20 and 21.
Wheat and Clover Days, Wednesday and Thursday, June 26 and 27.
Seedsman's Day, Thursday, August 1.
Dairy Day, Thursday, August 15.
Orchard Day, Friday, August 16.
Corn and Soybean Day, September ——.

These days are planned so as to give visitors an opportunity to see the various experiments at a time when the results can be studied to advantage and explained by members of the Station staff in charge. Many delegations and individuals visit the Station on other days and are always welcome, but those who come on the special days will have the additional advantage of hearing the discussions and one or more distinguished speakers.

Dairy Day program will include an inspection of the Station dairy herd, discussions of the experiments, and speaking. Some of the experiments underway or completed were planned to determine the protein requirement of cattle on pasture, the effect of rations on food value of milk, grinding roughages, predigesting feeds, minerals in the ration, "Manamar", fish meal, and iodine. Abortion disease and the economic phase of the dairy industry will be discussed. The dairymen are cooperating and will provide speakers for part of the program. The attendance last year dairy day was about two thousand.

Ohio Seedsmen's Day is a special day for Ohio seed dealers and others who are interested in good seed. Things to be seen include different varieties of oats, barley, corn, soybeans, and alfalfa; how new varieties are produced by breeding; experiments with vegetables, flowers, and orchard, and small fruits; experiments with lawn grasses. Speaking program in the afternoon. How can the Experiment Station and Agricultural College help the seedsmen? J. B. Park, professor farm crops, Ohio State University; The new Ohio seed law, E. C. Cotton, chief of Bureau of Plant Industry, State Dept. of Agriculture. Seed verification service of the U. S. Department of Agriculture. G. C. Edler, Dept. of Agricultural Economics, U. S. Department of Agriculture Standardization of vegetable varieties, speaker to be announced later. An opportunity will be given the seedsmen to organize a State Association if they so desire.

Orchard Day. On this annual day the work of the department of horticulture will be explained by the specialists in charge. A tour of the garden plots and orchards will be made in the morning and there will be a short speaking program in the afternoon. The orchards this year have set a normal crop despite the unfavorable weather thruout the spring. The work on fertilizers, spraying, dusting, pruning, fruit-setting studies, variety collections, small fruits and many other features will be explained. In addition those interested in flowers, vegetables and potatoes will have ample opportunity to examine this work in company with the specialists in charge.

The Bimonthly Bulletin

Sept.-Oct., 1929 Number 140

Ohio Agricultural Experiment Station

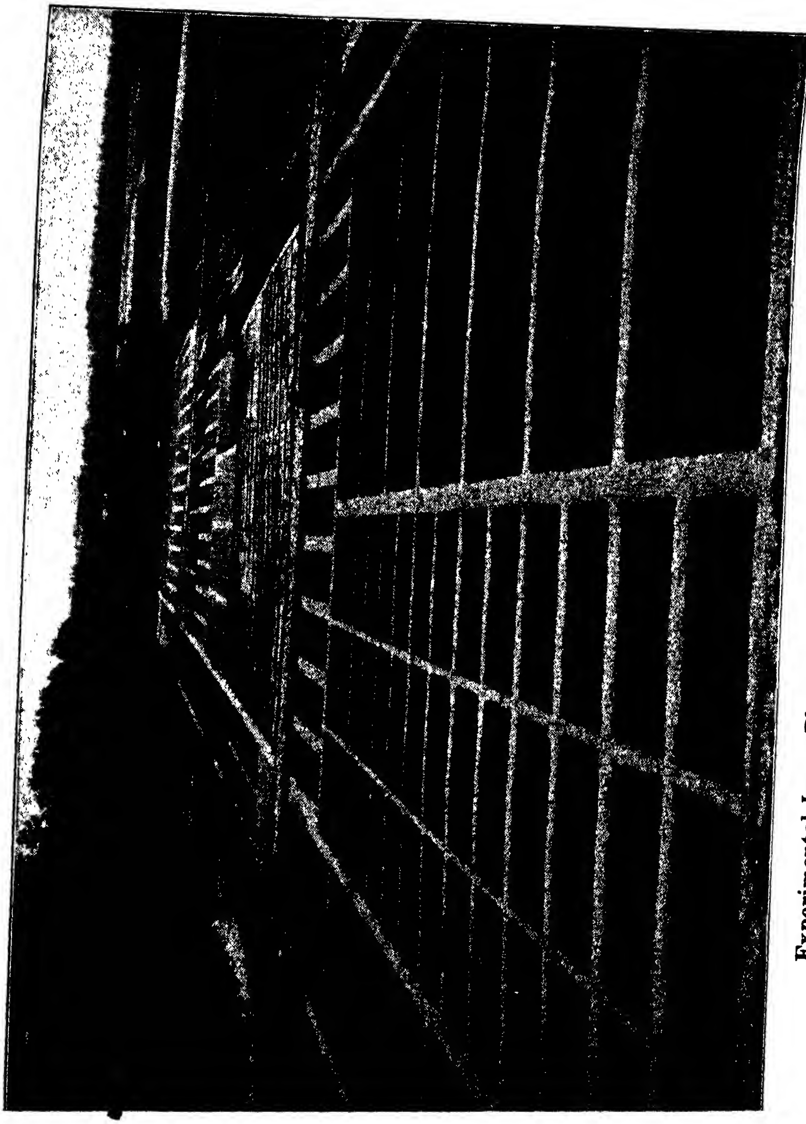
CONTENTS

WOOSTER, OHIO, U. S. A.

Free Bulletin

C. G. Williams

Director



Experimental Lawn Plots (taken from Better Lawns Circular)

Erratum: The Table on page 166 should be numbered 2 and placed on page 169; that on page 169 should be numbered 1 and placed on page 166.

PROTEIN SUPPLEMENTS IN RATIONS FOR FATTENING CALVES

PAUL GERLAUGH

Protein supplements to use with corn in a cattle ration is an important problem on many farms. Many Corn Belt farms buy most of their protein concentrates. Some of these farms are growing soybeans. The question naturally arises on these farms as to the use of soybeans as a protein supplement. Other feeders are wondering if they should grow soybeans to feed to their cattle.

Hereford heifer calves were fed during the winter of 1928-29 to obtain information on the use of linseed meal, cottonseed meal, and whole soybeans as sources of protein when fed at the rate of two pounds daily per calf. Similar calves were fed rations containing one pound of linseed meal or cottonseed meal daily in comparison with two pounds fed in the first two mentioned lots. In the lots fed one pound of protein supplement an additional pound of shelled corn was added so that the total concentrate ration, shelled corn and protein supplement, was the same.

The footnotes under the table give information relative to origin, cost, and final valuation of the calves.

When two pounds of linseed meal was fed daily the calves made 0.15 pound more gain daily than the calves fed a similar ration, excepting that two pounds of cottonseed meal replaced the linseed meal. This additional gain cheapened their cost and increased the profit but was not sufficient to change their selling value.

The linseed meal carried 34 percent protein, while the cottonseed meal contained 41 percent and consisted of five different brands mixed together.

The soybeans were of the Manchu variety and were fed whole.

The results of this test justify the following statements:

A unit of protein from linseed meal was worth more than a unit of protein obtained from cottonseed meal.

Two pounds of linseed meal was preferable to two pounds of cottonseed meal, when using the values listed in the table. Frequently there is more spread in price between the two feeds. In this case this advantage would be lessened.

Calves fed two pounds of whole soybeans daily ate less feed, made proportionately smaller gains, and were valued at a lower figure when marketed. The smaller feed consumption was probably due to the higher oil content of the ration.

Rapidity of gain is sometimes more important than at other times. During the season when these calves were marketed we invariably see a rising market on this class of cattle.

Had the soybean-fed lot of calves been carried three weeks longer they would have been as heavy and fat as the calves in Lot 1 were when sold. During this time there was a rise of 50 cents in the cattle market, which would have made the soybean-fed calves more profitable than either of the other lots. This simply shows that the ration which is conducive to most rapid gains is not always the most profitable.

TABLE 1.—Proteins for Calves

20 heifer calves per lot 5 pigs per lot	Lot 1 2 lb. Linseed meal	Lot 2 2 lb. Cotton-seed meal	Lot 3 2 lb. Whole soybeans	Lot 4 1 lb. Linseed meal	Lot 5 1 lb. Cotton-seed meal
Cost of calves at start of test, Dec. 18	$13.30	$13.30	$13.30	$13.30	$13.30
Average weight at start, Dec. 18	405	404	406	401	407
Average weight at close, April 16	652	633	619	629	634
Average daily gain	2.07	1.92	1.79	1.91	1.91
Average daily ration:					
Shelled corn	6.6	6.6	6.0	7.6	7.6
Corn silage	9.1	8.7	6.5	8.1	8.4
Mixed hay	1.9	1.8	1.3	1.7	1.8
Protein supplement	2.0	2.0	2.1	1.0	1.0
Feed required for 100 lb. gain:					
Shelled corn	322.0	346.6	339.5	397.4	398.2
Corn silage	440.7	452.7	366.2	422.8	440.4
Mixed hay	91.1	96.0	75.8	89.5	94.6
Protein supplement	96.5	104.15	117.1	52.3	52.3
Cost of 100 lb. gain	$ 9.60	$ 9.89	$ 9.87	$ 9.34	$ 9.25
Necessary selling price	11.90	12.07	12.12	11.87	11.85
Estimated value at Buffalo	14.00	14.00	13.75	13.75	13.00*
Estimated value at Cincinnati	13.75	13.75	13.75	13.75	13.25*
Estimated value at Cleveland	13.50	13.50	13.50	13.25	13.00*
Estimated value at Pittsburgh	13.50	13.50	13.25	13.25	13.00*
Estimated value in lots (average of markets less 85c.)	12.84	12.84	12.71	12.65	12.21*
Profit per calf (hogs not counted)	6.11	4.87	3.65	4.92	2.29
Profit per calf (crediting feed saved by hogs)	7.53	6.23	4.68	6.32	3.72

Corn 85 cents, linseed meal $60. cottonseed meal $53, soybeans $1.65, silage $5.50, mixed hay $14, salt 1 cent a pound; hogs $11.

Calves purchased from W. B. Mitchell, Marfa, Texas. Cost $12.50 per cwt., Texas weight, 3 percent shrink, freight paid to Wooster. We paid for feed enroute. All calves were treated; eighteen were quit sick, one died. Calves weighed 405 pounds, net, in Texas. Arrived in Wooster Nov. 24. Weight off cars 366 pounds. Weight three days later 385 pounds. Final appraisals by Bob. Martin, Buffalo; B. M. Duffy, Cincinnati; Fred Hollmer, Cleveland, and Harry Forman, Pittsburgh.

*Lower valuation of Lot 5 due to three "calfy" heifers. Market men stated that so far as condition due to feed was concerned Lot 5 should sell same as Lot 4. If the average daily gain of the three "calfy" heifers is reduced to same average daily gain as the remaining seventeen head, there is a discount of 111 pounds in total weight of lot. Using the discounted weight and the same value as given to Lot 4 the profit per calf in Lot 5 would be $4.36, not considering pork credit, and $5.80 each crediting feed saved by pigs.

Soybeans at $1.65 per bushel are valued high. Certainly if a farmer has them he is justified in using them and expecting satisfactory results. We feel that more farmers would be justified in growing soybeans for use as a cattle feed.

Linseed meal and cottonseed meal, fed at the rate of one pound of either daily, showed practically no difference between the feeds.

There was considerable variation in the size and weight of the calves on arrival. In dividing the group into the respective lots we attempted an equitable division so that an equal number of the light weight calves were in each lot.

The ten light weight calves in each of Lots 1 and 2 made a total gain of 4,667 pounds during the 119 days. The ten light weight calves in Lots 4 and 5 made a total gain of 4,269 pounds. The difference, practically 400 pounds, would indicate that two pounds of protein supplement was well worth while.

The ten heavy calves in each of Lots 1 and 2 made a total gain of 4,926 pounds for the entire feeding period. The ten heavy calves in Lots 4 and 5 made a total gain of 4,881 pounds after discounting for the calfy heifers, as per footnote.

These figures would indicate that one pound of protein supplement was not sufficient for the light weight calves while the heavier calves did as well on one pound of protein supplement as did the calves fed two pounds of either linseed or cottonseed meal.

The dividing line in the starting weights between the so-called light and heavy calves is just about the 400 pound mark. In other words, the calves that weighed less than 400 pounds at the start of the test gained considerably better when fed two pounds of protein supplement. The calves weighing more than 400 pounds at start of test did as well when fed one pound of protein supplement as when two pounds were fed.

The hogs following the calves showed no apparent difference between Lots 1, 2, 4, and 5. Lot 3 had less pork credit, probably because less corn was consumed by the calves.

The twenty pigs following the hundred calves made 1.3 pounds of gain for each bushel of corn fed to the calves. Each pig received .2 pound of "trio mixture" daily, but no corn was fed other than that salvaged from the calves.

Linseed meal did not make the calves scour. Cottonseed meal did not make the calves constipated. It was more difficult to keep the soybean-fed calves on feed. Occasionally a calf fed soybeans scoured badly. The calves fed linseed meal shed their hair a week to ten days sooner than those fed cottonseed meal.

CONTROL OF STINKING SMUT OF WHEAT

J. D. SAYRE

The common wheat smuts in Ohio are loose smut and stinking smut, or bunt. These two diseases of wheat are distinctly different in their appearance on the grain, in the type of their injury, and in the method of their control. They should not be confused.

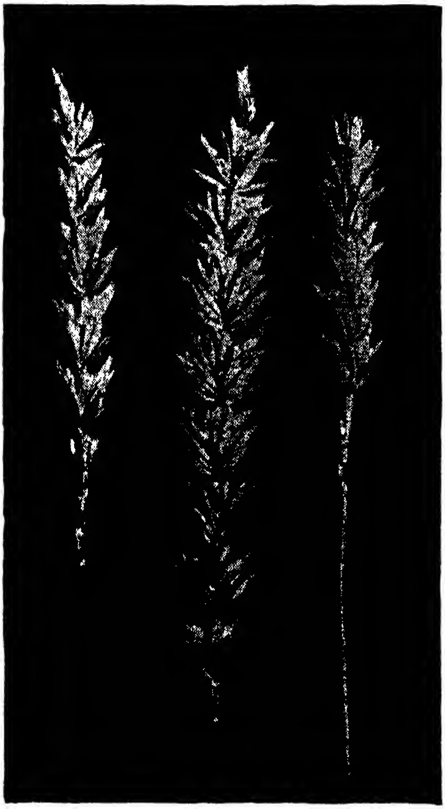


Fig. 1.—Typical heads of wheat bearing the bunt disease

Loose smut appears as black powdery masses at heading time. At first the smut is covered by a grayish membrane; but this membrane soon breaks and exposes the smut powder, which is promptly scattered. By the time the normal heads ripen, these conspicuous black heads disappear.

Stinking smut of wheat is much less conspicuous in the field than loose smut. While the wheat is still unripe close observation will reveal certain heads that are darker green and more plump than the normal. Internally such abnormal grains are filled with a dark, pasty mass—the spores of the smut fungus. These spores have an odor characteristic of fish-oil. This is especially noticeable when affected wheat seed is kept in an air-tight bin after threshing.

Bunted wheat must be cleaned by a special process before it can be milled; consequently, it brings a lower price than bunt-free wheat. Milling qualities of wheat are not injured by loose smut, but the yield is reduced.

The methods of control of these two wheat smuts are entirely different. Stinking smut may be eliminated by the application of a suitable dust fungicide. Loose smut, on the other hand, is controllable only by the special hot water method. This treatment is elaborate, even for small lots of grain, and is not recommended unless special equipment is available.

TABLE 1.—Results of Seed Treatment of Wheat

Type of dust used	Smutted heads
	Percent
Copper carbonate (40%)	1.55
Copper carbonate (20%)	1.85
Ceresan	1.09
P M A	0.89
Iodine	1.08
Smuttox (5% formaldehyde dust)	2.02
Copper carbonate and formaldehyde	1.35
Checks (untreated); average of 48	40.90

For the control of stinking smut a large number of dusts have been suggested and tried. Many of them proved expensive and ineffective. Other more promising ones have been tested at this Station. Wheat was dusted and then sown with an ordinary grain drill. One-hundredth acre plots were planted in four replications. The percentage of stinking smut in the several plots is summarized in Table 1.

All of the dusts reported here gave good control of stinking smut. Ceresan, P M A, and iodine were slightly more effective than the other dusts. Smuttox induced slight injury to the grain during germination and early growth. The other dusts did not produce such injury. Smut reduction with Smuttox was slightly less than with copper carbonate. On account of danger of injury, Smuttox is not advised for wheat seed treatment. On the other hand, no injury to oats has been experienced; therefore, it may be used in the control of smuts of oats.

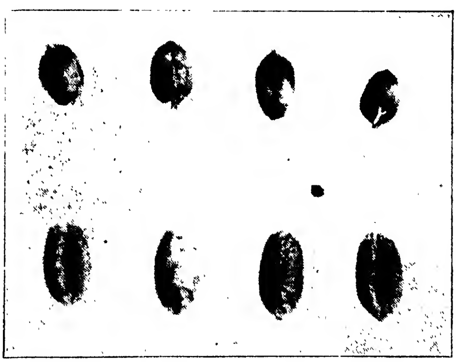


Fig. 2.—Above, smut balls; below, normal grains

There are certain requisites of a good dust fungicide for grain smut control: (1) the dust must be cheap, easily available, and simple to apply; (2) the dust must give satisfactory smut control;

(3) the dust must not injure the seed and seedling. None of the other dusts here reported meet these requirements quite as well as copper carbonate. It is true that Ceresan, P M A, and iodine were slightly more effective in the reduction of smut infection, but on account of their higher cost copper carbonate is preferred for stinking smut of wheat. Copper carbonate is available on the market under several different tradenames. All appear to be good. The dust is applied at the rate of two to three ounces for each bushel of grain. It is essential that each seed be thoroly coated with the dust; therefore, some sort of a closed container should be used in dusting the seed. An ordinary barrel, or an old churn may be used. On the market, there are several grain dusters which are convenient and commendable.

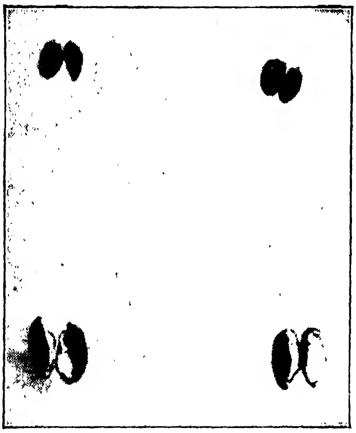


Fig. 3.—Showing the interior appearance of smut balls and healthy grains

SPECIAL CIRCULAR ON HORTICULTURE

WEEKLY PRESS BULLETIN

Horticulture at the Ohio Agricultural Experiment Station is the title of a 38-page special circular just issued by the Station to acquaint fruit growers and gardeners with the research and experimental work of the horticultural department.

The work was begun in 1893, when the Station was located at Wooster. Orchards were planted, vegetable and potato tests were laid out, and ornamental trees and shrubs planted on the campus and in suitable places about the farm. The outstanding feature of this earlier work was the testing of varieties. This feature has been continued altho the relative importance and emphasis have shifted to work of a more technical nature.

Information on thirty-four of the fruit, flower, and vegetable problems under investigation is presented in the circular by members of the department. Growers may receive a copy of this Circular by addressing the Experiment Station, Wooster, Ohio.

THE OHIO WHEAT FIELD INSECT SURVEY FOR 1929

E. C. COTTON*

The 1929 wheat field insect survey, as heretofore, was conducted as a joint project of the Ohio Agricultural Experiment Station, the Ohio State University, and the Ohio Department of Agriculture. In all 34 counties were covered, 19 of which were included in the 1928 survey thus permitting a direct comparison for the two years. Samples were taken in ten wheat fields in each of the 34 counties. The figures shown on the accompanying map are the average percentages of infestation of wheat stems, with hessian fly, in the respective counties.

With the exception of Butler County, where this year's percentage was double that of last year, the fly population in the wheatfields of the State was at a standstill or had decreased materially. This tendency to decrease is well shown in the case of Columbiana County, where the percentage was still high enough to call for rather strict adherence to the safe sowing dates, yet it is less than half that of last year. Taking the group of five counties of Columbiana, Stark, Medina, Wayne, and Holmes the average percentage of infestation this year was 3.8 as compared with 23.2 last year. Altogether the situation is very hopeful, yet it can be made very much otherwise by careless, early sowing of wheat this fall. One farmer sowing early, even with the present very light infestation, can raise enough hessian flies to severely injure, not only his own crop, but also to jeopardize that of his neighbors who do observe the safe dates. This is one project in which the whole community is deeply interested and one in which all must cooperate if it is to be a success.

A few fields were examined in the central part of the State in which very little fly was found in spite of the fact that the wheat in these particular fields was sown several days before the safe dates. Lest any be encouraged by the apparent success that attended this complete disregard of the recommended dates they are reminded that because of the severe drouth which prevailed at the time, early sown wheat lay unsprouted in the ground until after the adult hessian flies had largely disappeared. We cannot

*Chief of the Bureau of Plant Industry of the State Department of Agriculture.

hope for the aid of the weather every year, in this conflict, hence it behooves us to follow the safe sowing dates. The complete absence of the fly from the samples of wheat examined in Auglaize, Champaign, Delaware, Logan, and Union Counties may be partly explained by the same dearth of moisture at planting time.

Altho the 1929 wheat crop was comparatively free from infestation with joint worms, this insect was somewhat more prevalent than in 1928. The heaviest infestation found was 10 percent in one field in Fulton County. Outside of a small area in the northwestern part of the State it was present only as a "trace" or not found at all. The latter statement will apply also to the sheath worm. The midge or "red weevil" was reported only from Columbiana and Stark Counties where it was noted as "few".

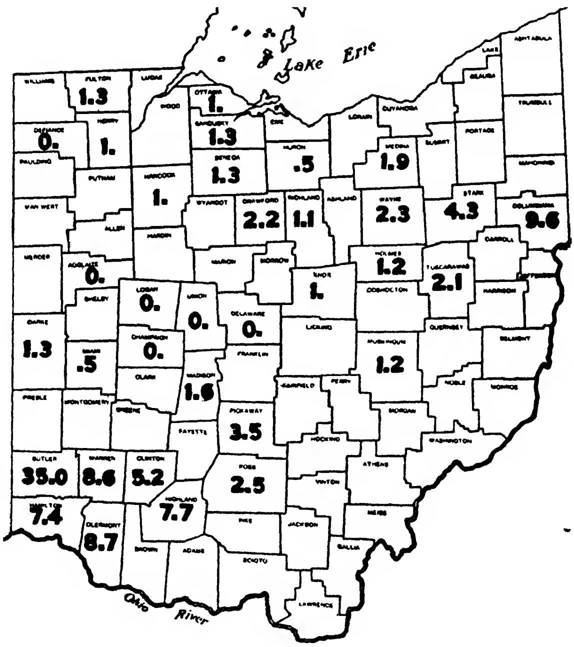


Fig. 1.—Figures show percentage of fly infestation

Of the ordinary wheat diseases, stinking smut, was reported from but two counties, Auglaize and Clermont, and then only as a "trace". Loose smut was more commonly present, being reported as from a "trace" to 3 percent in nearly every field visited. Scab was uniformly present, usually as a "trace", altho some fields suffered actual loss from its presence. This was particularly true

in Auglaize County, where two seriously infected fields were found, one with an 11 percent infection and the other with 40 percent. The variety in both instances was Improved Poole. Scab was apparently more prevalent in those fields where wheat followed corn in the rotation. In sections where the corn-wheat rotation is followed, it is highly desirable to sow only varieties that are at least partly immune to scab infection.

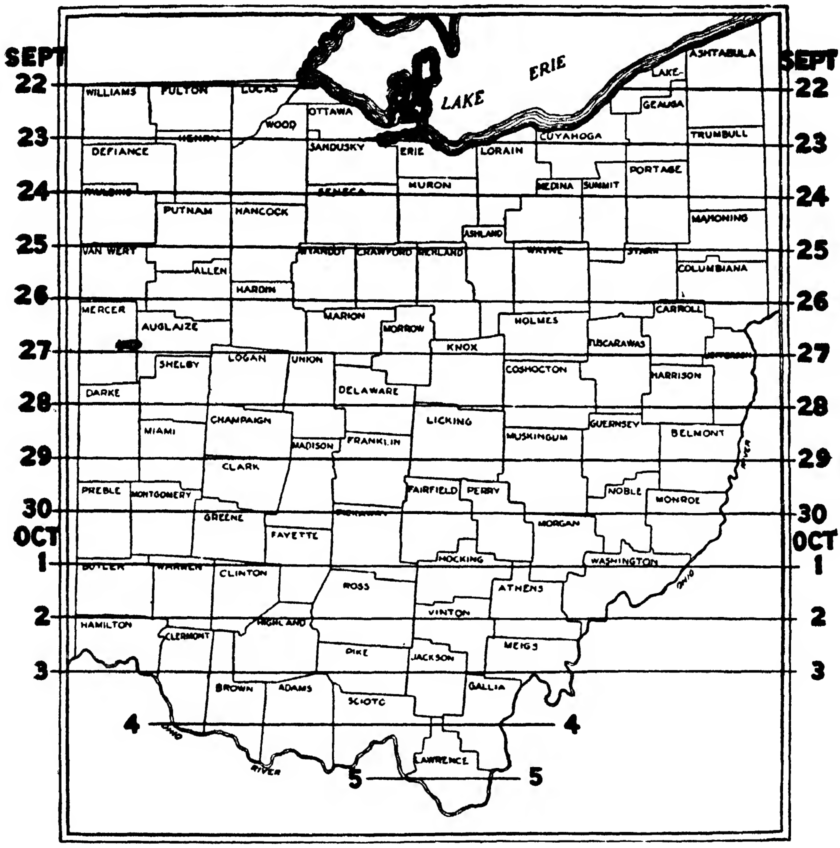


Fig. 2.—Hessian fly-free seeding dates

Black stem rust was found nearly everywhere present in the southwestern portion of the State. Leaf infection was present in practically all sections. In a few fields examined the disease had attacked the stems also, actual injury to the plants being observed in Clinton, Madison, and Ross Counties. One field in Ross County suffered an estimated loss in crop of 8 to 10 bushels per acre.

SHALL THE LAYERS BE CONFINED?

D. C. KENNARD

One of the foremost questions many poultry keepers face this fall is whether the pullets transferred from the range should be kept confined as layers. This is a rather new question, because the usual procedure in the past has been to provide the layers an outdoor range thruout the year. But this customary practice is being abandoned by many as a result of modern methods of feeding and management. The trend everywhere is towards confinement of the birds, so as to secure better control of weather and sanitary factors. It also permits a high degree of specialization and intensification which enables commercial poultry keepers to use business and factory methods and principles in the operation of their enterprise. The key to the untold possibilities in this connection is whether chickens can be successfully and profitably kept in confinement,* and whether a free range really proves beneficial or not. Realizing the importance of this question the Ohio Station is devoting much attention to it. One of the various tests relative to this subject during the past year at the Station may be of interest at this time.

PLAN OF EXPERIMENT

Three groups of 100 White P. R. pullets were placed on trial October 1, 1928, with the same ration, housing and management except the matter of confinement. Group 1 had an excellent free range of bluegrass; 2 had access to an 8 by 20 foot wire screen sunparlor on the south side of the house, but no range; 3 was confined indoors at all times.

Ration: The same for the three groups was fed as a coarse all-mash mixture and whole oats.

FORMULA

Coarse ground yellow corn	45
Coarse ground wheat	20
Whole oats	15
Bran	5
Meat scraps, medium	10
Dried buttermilk	5
Poultry bone meal	2
Salt	1
Cod-liver oil	1
Oyster shells (before birds at all times)	
Chopped alfalfa hay (before birds at all times)	

*Further details as to the history and results of keeping chickens in confinement may be obtained by writing the Station at Wooster for Bulletin 327.

The mash was fed at 3 to 5 p. m. daily in about the amount that would be consumed before the next feeding period.

MANAGEMENT

The windows were open to permit the admission of direct sunlight to all pens as weather permitted. Owing to delayed construction of sunparlor the birds of Group 2 were confined indoors until November 8 after which they were permitted to go outside in screen sunparlor at will. While they made considerable use of this privilege, and were outside during bad weather when it would not be expected that they would venture out, yet we suspected some never went outside and that in general the birds failed to go outside as much as they should. To correct this uncertainty, and to insure that every bird should have the advantages of the outside exposure, they were driven out into the sunparlor and shut outside at noon for 30 minutes daily, after April 3. A noticeable improvement in the birds was observed soon after this procedure was put into practice. The half hour exposure was changed to 4 p. m. after May 27 on account of the excessive heat during the middle of the day.

Results

Group number	Eggs per bird 10 months	Mortality Percent	Feed consumption 10 months
1. Bluegrass range	122	49	70.0
2. Wire sun parlor	127	36	73.5
3. Indoors	132	47	79.3

DISCUSSION OF RESULTS

Lowest egg production and highest mortality were secured from the range. The birds having screen sunparlor were half way between the other lots in egg production, but the rate of mortality was decidedly less.

These results are not conclusive because of their being based upon a single test and the high rate of mortality is always a difficult factor to interpret. In this case the mortality was so high as to make interpretation of the results of the test difficult and probably questionable. This will need to be corrected by repeated tests. However, the results are significant in various ways. The high mortality in all groups was due to condition of the pullets before they were put on test rather than to what they were subjected to afterwards. The mortality includes nine or ten from each lot

which died or were removed on account of paralysis or lameness. No attempt will be made to state what may have been the cause of these troubles altho coccidiosis and intestinal parasites may have been largely responsible, as a number of the birds were victims of both in varying degrees. At any rate this offers a clue to and probably the explanation of the abnormal loss of birds. Since this was the case it might be well to attempt to interpret the test from that viewpoint since so many pullets of this kind go into the laying houses.

How may pullets previously subjected to coccidiosis and intestinal parasites during brooding and summer range periods be affected if they are confined indoors where they will no longer come in contact with contaminated soil outside. It might seem that by confining the birds inside where the straw litter was removed and renewed each three weeks, they should become relieved from the disease and parasitic infestations without so much chance for reinfestation. The test gives little or no light on the question. The birds confined indoors with a supposedly complete ration had nearly the same rate of mortality as the range birds. Those having access to a sunparlor had considerably less mortality. Perhaps the direct sunlight factor was responsible for this when compared to the indoor birds. On the other hand when the range birds are compared with the ones having access to a sunparlor the sunlight factor is eliminated so that the less mortality in case of the latter might be due to throwing off disease and parasitic infestation and followed by less reinfestation.

LITTLE OR NO BENEFIT FROM THE RANGE

One rather definite result of this test was that an excellent bluegrass range failed to benefit the birds in any noticeable way. Similar results were secured from tests with brooding chicks and the summer growth of pullets where again the range failed to prove advantageous when the confined birds were properly managed and had a complete ration with adequate direct sunlight. Undoubtedly the question of free range involves both advantages and disadvantages which vary greatly with different locations and conditions. In case of the test in question the advantages of the range appear to have been offset by the disadvantages.

A good range can surely be considered the best solution of the problem of supplying green feed and direct sunlight. These are the positive advantages, but it appears that these important factors are too often overcome by closely associated disadvantages, such as

contaminated soil, weather conditions, and the fact that range birds may enjoy their outdoor range so that they neglect their duties inside. That is, a profitable layer must spend much time around the mash feeder and must limit accordingly her recreation out on the range which may offer so many pleasant attractions and diversions. To lessen this temptation it is a common practice to only let the layers out on range an hour or two in the evening.

The range may have the best of the argument when it comes to hatchability of the eggs, and yet the experience of poultrymen as well as the experimental evidence rapidly becoming available indicate that the poultry breeder is no longer obliged to provide the breeders a free range in order to secure good hatchability of eggs. It seems this may be procured as well or better by proper feeding and management. The hatchability in this test was based on the average of eleven different hatches from January 21 to May 13 and involving 2,500 or more eggs from each group. The percent chicks hatched from fertile eggs was 59, 52, and 55, respectively. These differences can hardly be regarded as significant. The fertility of eggs was practically the same in each group.

The feed consumption appears to line up with the egg production. At least there is little to indicate that the outdoor range furnished supplemental feed so the birds required less from the mash feeders, when egg production is taken into account. A question we do not attempt to answer is: Did the range birds eat less and lay less because they spent too much time outside at the expense of time they would have spent at mash feeders inside had they been confined, or were there other factors involved in connection with the range which proved a handicap? However, it was observed in this test that when the range was at its best and offered the most attraction for the birds the egg production was most in favor of the confined birds. On the other hand from December 27 to February 7, when the range birds were obliged to remain inside most of the time on account of the weather, their egg production slightly exceeded that of the regularly confined birds.

The test in question may be considered from different view points which might lead to various interpretations. The writer has endeavored to discuss some of the points and the interpretations that have been suggested by close observation made during the progress of the test. The tests are to be repeated in order to secure more mature evidence on the many questions involved.

In conclusion, it appears that if we are to be guided by this test and others and the experience of many practical poultry keepers, we need not regard a free range as a necessity for the layers or the breeders. In fact if the poultry keeper will effectively employ modern methods of feeding and management it seems that better success can be expected if the birds are confined and not permitted to come in contact with the soil. The key to success with birds in confinement is, a complete ration, which liberally includes direct sunlight, green feed, and milk, or their equivalents, and proper management.

RODENT INJURY OF FRUIT TREES

C. W. ELLENWOOD

Field mice, rabbits, groundhogs, and other rodents constitute a menace to the orchard. The amount of damage incurred from this source depends upon the season and location, but each year many orchardists make inquiry for methods of protection as well as treatment of injured trees.

Orchards growing in grass are more liable to injury than those in clean cultivation. However, injury may occur even during late summer or in cultivated orchards. There is always more injury in years of heavy snowfall.

Remove litter from base of tree.—Cleaning all litter and grass away from the base of the tree is the most important operation in preventing injury. No matter what other methods of protection are used the first essential is to eliminate all possible harbors for mice near the base of the tree. A circle two feet in diameter should be cleared. The earth should also be mounded up around the base of the tree to provide drainage and prevent undue drifting of snow.

CINDERS

Fine cinders applied 3 or 4 inches deep about the base of the tree aid materially in preventing mice injury. The cinders, however, ought not to be obtained from a plant where chemical refuse has been mixed with them.

WIRE PROTECTORS

The best mechanical protection is a guard made of galvanized wire netting. The guards are made from strips of netting 4 mesh to the square inch 18 by 18 inches or 15 by 15 inches. These pieces are readily made into cylinders and fastened by using the loose ends of the wire. These cylinders should be placed around the tree in the early fall and forced into the ground an inch or two to hold them firm. Once in place this type of guard may be left about the three thruout the season and as long as protection is necessary. An examination of these guards should be made in the spring and again in the fall. Occasionally wind will displace a guard and the tree may thus be rubbed or girdled.

OTHER TYPES OF GUARDS

Veneer and building paper also are used for tree guards. Guards made of these materials must be removed each spring to permit thoro spraying and prevent possible injury to the base of the tree.

PRINT PAPER WRAPPERS

A cheap protection, which has been used with entire success at the Station for several years, consists of wrapping the trees with heavy waste print paper. The paper is cut into the proper sizes and soft twine into convenient lengths to facilitate the work in the orchard. The paper is wrapped around the trees and tied. If it is tightly wrapped and well tied it will easily last thru the winter. A little earth thrown against the bottom of the paper will aid in keeping the wrapper in position. The cost of applying these guards to an orchard of 500 trees amounts to about 1½ cents per tree annually and of removing them in the spring ½ cent per tree.

TREE PAINTS

Altho the guards or wrappers probably are the safest protection against injury, there are a number of commercial and home-made paints that are effective.

Liquid lime-sulfur applied full strength, or dry lime-sulfur dissolved in enough water so that it may be applied with a brush serves as a rabbit repellent.

Fresh blood from slaughter houses painted on the trees is effective for a time. An old mixture, which has been used with good results and which has the advantage of adhering thruout the year, is made as follows: 4 lb. of flour, 4 lb. dry lime-sulfur, 2 lb.

of yellow ochre, 1 pint linseed oil, 4 ounces of asafetida, and enough sour milk to mix to the consistency of paint. It is then applied with a brush. The recipe will provide enough for 300 to 400 trees planted two years.

POISON BAIT FOR MICE

Both meadow mice and pine mice are found in Ohio. The meadow mouse makes shallow tunnels and nests in surface vegetation. Injury from this mouse is usually above the ground. Tunnels of the pine mouse are deeper and consequently the damage done by this mouse is usually below the surface.

While the first essential in preventing injury by mice is to remove all litter from the base of the tree, there are several recipes for making poison bait for mice. One of these baits is made as follows: Mix 1/8 ounce of powdered strychnine and 1/8 ounce of baking soda and sift over 1 quart of rolled oats. Place the rolled oats in an oven until thoroly warm, then stir the strychnine and soda into oats until thoroly coated, six tablespoonfuls of hot beef grease-paraffin, prepared by mixing 1 part paraffin to 3 parts of beef grease. The beef grease-paraffin coating protects the poisoned rolled oats against atmospheric moisture. Teaspoonful quantities of the poison bait should be placed in mouse runways or holes, but preferably in such receptacles as small tin cans, milk bottles, or wooden containers which will admit the mice but exclude birds and other animals. A box 6 inches square and 1½ inches high has been suggested as a bait container. The box is put against the tree, covered with grass and weighted down. Variations of the foregoing recipe have also been successfully used. Gloss starch may be substituted for the oats. Syrup and glycerine are sometimes included in the mixture. Wheat may be used to carry the poison bait.

OTHER METHODS OF MOUSE CONTROL

Skunks and birds, which feed on mice, should be protected and encouraged. A small dog, either the black and tan rat terrior or fox terrior, is most useful in killing mice. Some growers keep dogs and cats especially for this purpose.

HOW LONG DO TREES REQUIRE PROTECTION

Rabbits as a rule do not seriously injure trees after the first 5 or 10 years. They apparently prefer younger and more succulent growth.

Mice have been known to completely girdle 30 year old trees. Mice injury, however, is much more common on trees under 15 years. Removal of litter and grass from the base of trees under 15 years in the early fall is very important.

TREATMENT AFTER INJURY

If the injury consists of only partial girdling as is often the case it may be sufficient to cover the wound with some material to prevent evaporation. There is nothing better than grafting wax for this purpose. Lead oil paint may also be used. If the wound extends half way around the tree or more it should be bridge grafted.

BRIDGE GRAFTING

Mouse injury is frequently beneath the ground surface. Wounds of this character may not be detected until the foliage begins to turn yellow the following summer. In such cases it is generally too late to save the tree. If the injury is detected during the winter or early spring the wound should be covered with grafting wax and bridge grafted about the time growth starts.

Bridge grafting consists of inserting a cion over the wound, the lower end an inch or two beneath the wound and the upper end above the wound. The important essentials in bridge grafting are: first, that cions be in good condition, dormant but not dry, and that terminal growth made the preceding year or well ripened water sprouts be used for cions; second, that, in setting the cambium layer or inner bark of the cion and tree unite; third, that the cion be a little longer than is necessary to cover the wound so that it will be slightly arched. The cion may be inserted in the tree by lifting the bark with a chisel or it may be inarched. The latter method involves the removal of a wedge-shaped section of bark and cutting the cion into a wedge form that will fit tightly into the cut in the tree. The cion is then held in place at the point of insertion by a brad or small tack. No matter what method is used to set the graft the point of union should be thoroly covered with grafting wax.

An occasional examination of the grafts should be made to see that the cions have not loosened and that the union is covered with wax. It is important that the buds on the cion be not permitted to develop. They should be removed during the first year or so after grafting.

The number of cions necessary to use in bridge grafting a tree depends upon the size of the tree as well as the extent of the wound. A cion every 3 or 4 inches is generally enough, altho on small trees it may be necessary to set them closer.

OTHER USES FOR BRIDGE GRAFTING

Bridge grafting may also be used to preserve or prolong the life of apple trees injured by collar rot or sun scald. Injuries of this nature sometimes necessitate the use of one or two year old trees instead of cions. The young tree is merely planted alongside the older tree and the top inarched into the older tree above the wound.

GRAFTING WAX

The following has been a standard recipe for grafting wax for many years: Melt together 4 parts (by weight) of finely ground rosin; 2 parts of beeswax, and 1 part of tallow. Pour the mixture into a pail or tub of cold water. As the mass begins to cool so that it can be handled, grease the hands with tallow and pull and work the lump until it becomes quite light in color. It may then be formed into sticks or balls for convenient use. This wax will keep indefinitely.

Linseed oil may be substituted for the tallow, making the wax a little softer. This wax may be applied as a liquid wax by the use of an alcohol lamp or glue.

A soft wax for applying with a brush may be made by the use of 2 parts rosin, ½ part beeswax, and 1 part linseed oil. Paraffin substituted for beeswax is not satisfactory. Waxed strings or cloth may be made by saturating them in melted wax.

EARLY RED, PINK, AND WILT-RESISTANT TOMATOES IN 1928 TEST

ROY MAGRUDER

The number of varieties of tomatoes having increased tremendously within the last few years, it was thought advisable to conduct an experiment to determine which are really new and distinct and which are old types with new names. The yields and a brief description of some of the early red, pink, and wilt-resistant varieties are given. Midseason and late red varieties are not included.

In order to keep the number of samples in the experiment to a minimum, only the specialties of the different seedsmen were grown. A few of the well known varieties and some new varieties that were not recommended as first or second earlies were included for comparison.

The seed was planted March 12 in the greenhouse in flats of sterilized compost, and the plants were shifted April 5 into flats where they were spaced 2¾ inches apart each way. The plants grew rapidly and were about 8 inches tall, stocky, and either blooming or ready to bloom when set into the field May 22.

Twenty plants of each sample were set 2 feet apart in rows 4 feet apart. Ten of these were pruned to a single stem each and tied to a stake, and ten were not pruned nor tied up but allowed to grow and spread naturally over the ground.

The soil is Wooster silt loam and, altho tile drained, is rather retentive of moisture and warms up slowly in the spring. About twenty-five tons of stable manure was plowed under and a broadcast application of 200 pounds of sulfate of ammonia and 500 pounds of 16 percent superphosphate per acre was disked in when preparing the soil for planting.

Fruits were harvested two or three times weekly during the early part of the season and once a week later. They were picked as soon as the stem end turned pink, and each lot was graded, counted, and weighed separately. First grade consisted of smooth fruit 2¼ inches or more in diameter; second grade of all smaller than this and of very rough or misshaped fruits.

A light frost on May 24 and continued cool, rainy weather in June were responsible for a light early set. The later clusters set well, but an unusually large amount of leaf spot, favored by the

TABLE 1.—Percentage of Total Weight Harvested Each Week

Selected tomato varieties—Unpruned—1928

Variety	Seedsman	Week 1	2	3	4	5	6	7	8	9	10	11	12
Early red varieties													
Viking	N. D.	0.2	0.3	0.8	4.5	11.0	2.8	43.0	32.8	4.3	......	......	......
Fargo	N. D.	......	1.3	2.7	3.4	7.7	5.1	45.6	28.0	5.9	......	......	......
Extra Early Mascot	Simon	.1	1.2	.6	1.1	5.8	1.6	39.2	33.8	10.9	5.4	......	......
Earliana No. 498	Morse	......	.8	.2	1.4	5.3	5.3	43.3	29.3	12.0	2.2	......	......
Extra Early Prolific	Hastings	......	1.2	......	1.9	8.9	3.9	54.5	27.1	2.5	......	......	......
Bonny Best (Forcing)	Stokes	......	.4	.1	.6	4.9	2.6	37.2	35.8	18.3	......	......	......
Bonny Best	Harris	......	.9	1.1	1.6	1.8	2.1	47.0	36.3	8.9	......	......	......
John Baer	Harris	......	.5	.2	.5	2.9	1.3	21.5	28.9	36.8	7.1	......	......
Nettany	Pa. S. C.	......	......	......	.5	1.7	1.0	6.6	25.5	38.8	19.2	6.1	.4
Matchum	Pa. S. C.	......	......	......	1.5	4.0	1.1	11.7	24.4	29.1	19.7	8.2	......
Pink varieties													
Alpha Pink	Isbell	.1	1.5	.4	1.2	4.8	6.9	55.7	22.7	6.5	......	......	......
Cooper Special	Ferry	......	......	......	.4	2.0	.1	4.8	24.0	38.6	21.0	8.4	.5
Gulf State Market	Reuter	......	......	......	.3	1.5	2.8	4.5	38.6	22.7	17.4	11.7	.3
Early Detroit	Ferry	......	......	......		1.3	.6	4.9	23.7	24.3	23.1	19.8	2.1
Purple Acme	Hastings	......	......	......	......	3.4	.5	25.1	36.9	24.5	8.7	.7	......
Beauty	Rice	......	......	......	......	.6	.3	6.4	22.2	23.6	24.9	19.3	2.6
Magnus	Livingston	......	......	......	......	......	......	.1	13.3	8.4	20.3	53.8	4.1
Rosy Morn	Livingston	......	......	......	......	.2	.3	6.6	21.8	29.1	25.1	16.5	.3
Royal Purple	Rice	......	......	......	......	.8	.3	4.9	19.2	24.7	17.8	29.5	2.6
Globe	Livingston	......	......	......	......	1.4	.5	4.9	23.7	32.3	19.8	14.9	2.3
Wilt resistant varieties													
La. Pink	Reuter	......	......	......	.4	1.1	......	9.1	19.8	30.8	22.6	13.3	2.7
La. Red	Reuter	......	......	......	.4	1.8	1.3	5.0	28.8	24.2	23.0	14.3	1.0
Marvana	U. S. D. A.	......	.2	.5	1.5	4.7	4.7	20.5	25.5	19.8	19.3	3.1	......
Marvelosa	U. S. D. A.	......	......	......	.2	.8	2.2	1.8	19.8	18.1	16.4	35.7	4.6
Marglobe	U. S. D. A.	......	......	......	1.9	2.1	1.3	2.0	11.6	20.5	23.3	32.8	4.5
Marvel	U. S. D. A.	......	......	......	.3	2.4	1.3	3.5	19.8	22.0	25.6	22.8	2.0
Columbia	U. S. D. A.	......	......	......	.1	1.2	.9	2.9	15.1	19.9	26.8	27.4	5.5
Norduke	U. S. D. A.	......	......	......	.2	.8	......	......	1.3	6.1	27.2	58.2	6.0
Norton	U. S. D. A.	......	......	......	......	1.0	.1	3.1	20.7	17.8	15.0	36.3	5.9

Variety	Seedsman	Pruned and staked				Unpruned				Date of first harvest	Date of last harvest
		Firsts by weight Pct.	Rank	Weight firsts Lb.	Rough seconds Pct.	Firsts by weight Pct.	Rank	Weight firsts Pct.	Rough seconds Pct.		
Miscellaneous red varieties											
McClintock	Ford	78	....	.373	40	80	....	.312	3	8/ 9	7/28
Perfection	Sutton	63	....	.241	9	33	....	.228	4	7/16	7/21
Nettany	Pa. S. C.	83	....	.410	34	79	....	.330	9	8/ 1	9/28
Matchum	Pa. S. C.	80	....	.344	48	67	....	.317	5	8/ 1	9/21
Pink fruited varieties											
June Pink	Rice	85	6	.344	26	59	10	.322	30	7/16	9/ 4
Alpha Pink	Isbell	78	10	.313	42	68	7	.304	68	7/11	9/ 4
Earliest Pink	Ford	81	9	.332	38	68	7	.271	54	7/20	9/ 4
Purple Acme	Hastings	69	12	.337	46	57	12	.311	16	8/ 7	9/21
Norfolk	Tait	78	10	.308	52	67	8	.316	11	8/ 7	9/28
Early Detroit	Ferry	84	7	.358	9	77	2	.369	14	8/ 7	9/28
Beauty	Rice	76	11	.358	62	70	5	.312	10	8/ 7	9/28
Gulf State Market	Reuter	85	6	.393	27	69	6	.353	10	8/ 1	9/28
Royal Purple	Rice	90	3	.398	45	78	1	.353	16	8/ 9	9/28
Purple King	Adams	90	3	.430	31	69	6	.319	7	8/ 1	9/28
Everbearing	Holmes	88	4	.421	18	69	6	.319	7	8/ 7	9/21
Magnus	Livingston	83	8	.341	17	50	13	.271	17	8/21	9/28
Rosy Morn	Livingston	85	6	.333	29	77	2	.340	9	8/ 7	9/28
Cooper Special	Ferry	87	5	.406	15	58	11	.299	3	7/30	9/28
Globe	Livingston	95	1	.512	27	74	4	.362	3	8/ 7	9/28
Walter Richards	Landreth	94	2	.458	23	76	3	.345	4	8/ 1	9/28
Redfield Beauty	Hastings	69	12	.334	37	66	9	.293	7	8/ 9	9/28
Wilt resistant varieties											
La. Pink	Reuter	84	2	.404	94	65	9	.300	10	7/30	9/28
La. Red	Reuter	80	4	.361	34	53	10	.278	5	7/30	9/28
Marvana	Ford	....	....	....	....	52	11	.255	22	7/16	9/28
Marvana	U. S. D. A.	77	5	.311	77	66	8	.281	10	7/16	9/21
Marvelosa	Ford	....	....	....	....	70	5	.325	14	8/ 7	9/28
Marvelosa	U. S. D. A.	81	3	.330	12	66	8	.303	6	7/30	9/28
Marglobe	Ford	....	....	....	....	68	7	.327	8	8/ 1	9/28
Marglobe	Stokes	....	....	....	....	77	4	.361	8	8/ 3	9/28
Marglobe	U. S. D. A.	87	....	.453	44	69	6	.314	7	7/30	9/28
Marvel	U. S. D. A.	....	....	....	....	66	8	.278	6	8/ 1	9/28
Columbia	U. S. D. A.	....	....	....	....	83	2	.337	27	7/30	9/28
Norduke	U. S. D. A.	....	....	....	....	82	3	.331	8	8/ 3	9/28
Norton	U. S. D. A.	....	....	....	....	92	1	.393	34	8/ 7	9/28

excessive rainfall of June and July, killed the foliage early in August and greatly reduced the bearing period and yield of the early varieties.

The percentage and average weight of first grade fruit, the percentage of seconds that were placed in this grade because of roughness or irregular shape, the date of first harvest, and the last harvest of ripe fruit of the varieties of each group are given in Table 1. The first three of these items are given for both pruned and unpruned plants, and varieties within the group are ranked accordingly.

The percentage of rough seconds is based on the last month's harvests, as this item was not recorded earlier. A low percentage of rough seconds indicates that most of the seconds were small.

The dates of the first and last harvests of ripe fruit from the unpruned plants give the relative earliness and length of the bearing season of the varieties.

No mention is made of yield per plant, since it is felt that the number of plants involved in this test was too small to give significant results.

Table 2 shows the harvesting record of selected varieties, unpruned, in each group. It shows the relative earliness, time at which maximum production was reached, and the rate of decline in yield.

EARLY RED VARIETIES

It was soon evident that the majority of the early red varieties belonged to two well defined groups, which have been given the name of the oldest or most widely known variety within the respective group.

Earliana group.—Vines small-leaved, with short, slender, weak-growing branches; flower clusters large; fruit more or less flattened, round to oval in cross section, rough or corrugated and with a green "collar" around the stem end, some with open or rough "cat-faced" blossom end; color yellowish red, with light green or yellow lines radiating from the blossom-end before the fruit is fully ripe, when they usually disappear; skin and side walls thin, cracking badly in concentric circles around the stem end during wet weather. Because of the thin walls and watery consistency of the interior, fruits of this group do not ship nor keep well. The plants have a rather short bearing period. If grown on light or poor soil or during dry seasons, the fruit diminishes rapidly in size after the peak of production is reached.

This group, because it is the earliest, is still popular in spite of its objectionable features. Selection toward smoothness and increased depth of fruit has considerably improved the original type.

TABLE 2.—Percent of First Grade, Average Weight Per First Grade Fruit and Percent of Rough Seconds

Tomato varieties 1928

Variety	Seedsman	Pruned and staked				Unpruned				Date of first harvest	Date of last harvest
		Firsts by weight Pct.	Rank	Weight firsts Lb.	Rough seconds Pct.	Firsts by weight Pct.	Rank	Weight firsts Lb.	Rough seconds Pct.		
Avon Early	Ferry	84	3	300	36	65	8	.237	16	7/16	9/11
Burbank	Ford	80	5	.321	29	60	10	.270	22	7/11	9/ 4
Canadian	Harris	69	11	.296	11	62	9	.280	17	7/16	9/11
Earliana	Landreth	76	6	.291	8	65	8	.266	18	7/16	9/ 4
Earliana No. 498	Morse	72	9	.300	14	65	8	.301	39	7/16	9/11
Earlibell	Isbell	74	8	.286	56	67	7	.271	33	8/ 1	9/ 4
Earliest of All	Salzer	74	8	.309	40	69	5	.276	9	7/16	9/11
Early Prolific	Eberle	87	1	.319	25	62	9	.264	6	7/16	9/21
Early Sunrise	Woodruff	70	10	.273	5	74	3	.295	17	7/16	9/11
Extra Early Mascot	Simon	81	4	.338	32	71	4	.236	21	7/11	9/11
Extra Early Prolific	Hastings	80	5	.334	40	81	1	.288	27	7/16	9/ 4
Fargo	N. D.	61	14	.321	....	27	13	.275	....	7/20	9/ 4
First Early	Tait	76	6	.308	12	68	6	.228	14	7/16	9/ 4
Gregory	Gregory	85	2	.307	53	65	8	.272	13	7/16	9/ 4
Pa. State Earliana	Pa. S. C.	75	7	.289	16	49	11	.240	15	7/11	9/11
Red River	N. D.	67	13	.270	10	65	8	.278	6	7/11	9/11
Viking	N. D.	68	12	.265	....	76	2	.289	....	7/11	9/ 4
Wayahead	Johnson	74	8	.325	21	40	12	.293	25	7/11	9/11
Bonny Best group											
Bonny Best 104	McFarland	85	6	.328	26	70	5	.295	8	7/26	9/11
Bonny Best	Harris	86	5	.316	8	72	3	.295	7	7/16	9/ 4
Bonny Best Forcing	Abbott & Cobb	83	8	.323	13	70	5	.290	10	7/16	9/ 4
Bonny Best Forcing	Stokes	88	3	.374	45	73	2	.304	13	7/20	9/ 4
Bonny Best Super Std.	Stokes	90	1	.336	50	63	8	.278	8	7/16	9/ 4
Early Marketeer	Isbell	90	1	.364	33	71	4	.296	18	7/20	9/ 4
Garland	Ford	78	12	.347	47	61	9	.304	8	7/20	9/ 4
John Baer	Schell	79	11	.320	14	60	10	.314	3	7/20	9/11
John Baer	Hart & Vick	83	8	.360	27	68	6	.306	14	7/16	9/11
John Baer	Harris	87	4	.377	25	74	1	.299	6	7/20	9/11
John Baer	Ferry	89	2	.357	29	73	2	.307	5	7/24	9/21
Michigan Red Wonder	Isbell	81	9	.353	31	74	1	.244	4	7/16	9/11
Norfolk	Moore	80	10	.323	26	70	5	.272	6	7/20	9/ 4
Perfect First Early	Reuter	74	13	.336	23	66	7	.320	21	8/ 1	9/11
Red Head	Rice	84	7	.356	31	59	11	.289	4	7/20	9/ 4

Following are characteristics of the varieties in this group:

Avon Early—Ferry. Small, smooth, deep fruited.

Burbank—Ford. Smooth, deep fruited.

Canadian—Harris. Ordinary strain.

Earliana—Landreth. Ordinary strain.

Earliana—No. 498, Morse. Large, flattened.

Earlibell—Isbell. Ordinary strain.

Earliest of All—Salzer. Smoothest deep-fruited strain when unpruned but on stakes no better than ordinary.

Early Prolific—Eberle. Smooth, deep-fruited strain.

Early Sunrise—Woodruff. Smooth, deep-fruited strain, too small on stakes.

Extra Early Mascot—Simon. Large selection.

Extra Early Prolific—Hastings. Large selection.

Fargo—N. D. Exp. Station. Short branches ending in numerous large flower clusters. Fruit small, round, smooth, cracks badly, not suitable for staking.

First Early—Tait. Ordinary strain.

Gregory—Gregory. Large, flat selection.

Pa. State Earliana. Small, smooth, deep-fruited strain.

Red River—N. D. Exp. Sta. Small, smooth, deep-fruited strain.

Viking—N. D. Exp. Sta. Plant smaller than Fargo; fruit of flattened, rough Earliana type; not suitable for staking.

Wayahead—Johnson. Potato leaved, not as vigorous as standard foliage plant. Ordinary Earliana type of fruit.

Bonny Best group.—Vines and foliage large, vigorous; flower clusters medium in size; fruit deep, round to slightly flattened at both ends, round to oval in cross section, smooth around stem end, ripening uniformly to stem, does not crack as badly as Earliana or the pink varieties, but when it does the cracks appear radially from the stem attachment, medium size, bright clear red, solid, only a few days later in ripening than Earliana.

The plants are very susceptible to disease. In disease-free soil, and in normal seasons the plants continue to bear marketable fruits until frost.

This group is most used in Ohio for the early crop because of its high quality fruit, long bearing period, productivity, and its suitability for growing on stakes. The following varieties belong in this group:

Bonny Best 104—McFarland. Slightly flattened, round fruit.

Bonny Best—Harris. Very smooth, deep, round, medium size fruit.

Bonny Best Forcing Strain—Abbott & Cobb. Slightly flattened, round fruit.

Bonny Best Forcing Strain—Stokes. Large, slightly flattened, round fruit.

Bonny Best Super Std.—Stokes. Medium size, flattened, round fruit.

Early Marketeer—Isbell. Large, flattened, round to oval fruit.

Garland—Ford. Large, flattened, round to oval fruit.

John Baer Special—Schell. Large, slightly flattened, round fruit.

John Baer Special—Hart & Vick. Contained both slightly flattened and deep types.

John Baer Special—Harris. Large, flattened, round to oval fruit.

John Baer Special—Ferry. Contained both slightly flattened and deep types.

Mich. Red Wonder—Isbell. Medium size, slightly flattened, round fruit.

Norfolk—R. Moore. Variable in shape, flat to deep, round.

Perfect First Early—Reuter. Slightly flattened, round fruit.

Red Head—N. D. Exp. Sta. Medium size, deep, round fruit.

MISCELLANEOUS RED VARIETIES

McClintock—Ford. Late maturing, with heavy foliage and large plant; fruit medium to large in size, slightly flattened, round, very smooth, ripens well to stem end, dark red in color and very solid. Belongs in the Stone group.

Perfection—Sutton. An English variety with long branches and heavy foliage, bearing large clusters of small, slightly flattened, round, very smooth, bright red fruit. As early as Bonny Best and the foliage is more resistant to leaf spot. Too small for our markets.

Nittany—Pa. State College. Large, vigorous vine; fruit large, flattened, round to oval in cross section, smooth, ripens well to stem end, dark red color, solid, midseason in maturing.

Matchum—Pa. State College. Same type vine as Nittany but fruit slightly earlier, smaller, smoother, and deeper.

PINK OR PURPLE FRUITED VARIETIES

June Pink—Rice. A pink fruited Earliana.

Alpha Pink—Isbell. A pink fruited Earliana.

Earliest Pink—Ford. A pink fruited Earliana.

Purple Acme—Hastings. Vine heavy, medium length; fruit small to medium size, flat, round, slightly corrugated around stem end with hard, more or less prominent blossom-end scar and a high percentage of cat-faced and rough fruit when grown on stakes.

Norfolk—Tait. Same as Purple Acme.

Early Detroit—Ferry. Large, vigorous plant with large, deep, round, smooth fruit.

Beauty—Rice. Slightly larger and later than Purple Acme, otherwise much like it.

Gulf State Market—Reuter. An early strain of Globe.

Royal Purple—Rice. Might be called an improved Beauty, as it is smoother around the stem end, and slightly deeper with a less prominent blossom scar.

Purple King—Adams. Same as Globe.

Everbearing—Holmes. Same as Globe.

Magnus—Livingston. Short, heavy vine with potato-leaf foliage. Fruit small to medium in size, fairly deep, round, smooth. Very late and a light producer.

Rosy Morn—Livingston. Short, heavy vine more susceptible to leaf spot than other midseason pinks. Fruit medium size, deep, smooth, rosy pink in color.

Cooper Special—Ferry. Short stemmed but vigorous plant. Fruit small to large in size, deep but flattened on stem and blossom end. Not suited for

staking as it developed yellow "collar" around stem end and was flattened between cross walls.

Globe—Livingston. Large, vigorous plant with long internodes. Fruit varies from small, slightly pointed, and round to large, flattened, oval in cross section and inclined to be rough. Ripens well to a small shallow stem end, very productive.

Walter Richards—Landreth. Same as Globe.

Redfield Beauty—Hastings. Same as Beauty.

The midseason pink varieties are somewhat resistant to leaf spot diseases.

WILT-RESISTANT VARIETIES

This list contains most of the commercially distributed wilt-resistant varieties. It was noticed that all of these varieties are more resistant to leaf-spot diseases than the standard varieties of the same season. This results in a longer bearing period.

La. Pink—Reuter. Large vigorous plant with long slender branches and medium size leaves. Fruit small to medium in size, deep, round, smooth, some with green collar around small stem end. Cracks around stem end.

La. Red—Reuter. Plant and fruit somewhat smaller than La. Pink; fruit bright red in color; neither as early nor as desirable as Marvana.

Marvana—U. S. D. A. Vine of same type as Earliana but more vigorous. Fruit small to medium in size, fairly deep, round. Compares favorably with non-resistant strains.

Marvana—Ford. Smaller and rougher strain than U. S. D. A.

Marvelosa—U. S. D. A. Medium length, thick stemmed vigorous vine, with leaves slightly larger than Marvana. Fruit medium in size, deep, flattened on ends, round and oval in cross section, clear pink in color, very solid. Altho not as large as standard midseason pink varieties it compares favorably with them.

Marvelosa—Ford. Slightly larger and rougher strain.

Marglobe—U. S. D. A. Very large vigorous plants with large, heavy foliage. Fruits medium to large in size, deep, flattened on blossom end and slightly tapering from stem end, dark red in color, very solid. Not suited for staking when grown on heavy soil or in wet seasons as it cracks deeply and produces many rough fruits. The most popular of the wilt-resistant varieties.

Marglobe—Ford. Slightly larger strain.

Marglobe—Stokes. Larger and later selection.

Marvel—U. S. D. A. Large, vigorous plant with small to medium size, fairly deep but flattened, round, red fruit.

Columbia—U. S. D. A. Very large vigorous plant with large, flat, round to oval, inclined to be rough, red fruit. Too flat and rough.

Norduke—U. S. D. A. Very large vigorous plant. Fruit medium to large, deep, round to oval, smooth, dark red, very late.

Norton—U. S. D. A. A wilt resistant Stone; fruit large, round, deep, smooth, evenly ripening, solid, dark red.

THE COMBINED HARVESTER-THRESHER IN OHIO IN 1928

J. H. Sitterley

The combined harvester-thresher, more commonly known as the "combine", is a machine that cuts and threshes the grain in one operation. The combine machines have been used in the western states for many years but not until 1926 were they introduced into Ohio. In 1928 there were known to be 87 combines in Ohio, almost all of which were located in the level or gently rolling grain producing areas of the western half of the State.

Following the 1928 harvest season, 75 of the combine owners were personally interviewed by the writer. A majority of the combines were of the 10-foot size, the average cost of which was $1,450. The 75 owners interviewed harvested 14,371 acres in 1928, or an average of 192 acres per combine. The rate of harvest varied from less than 0.5 acre to more than 3.5 acres per hour; the average was 1.7 acres per hour.

The hours that the combine could be used each day depended quite largely on the weather. The average starting time was 10 a. m. and the stopping time was 6 p. m., making possible 8 hours of harvest per day. There were many days when only a few hours of operation was possible, others when the combine could not be operated, and still others when more than 8 hours of harvest were accomplished.

Approximately one man-hour was required to harvest an acre of grain with a 10-foot combine, and five man-hours were required to harvest an acre of grain with a tractor-drawn binder and stationary thresher (1). A crew of 2 men was all that was needed to accomplish the task with the combine, whereas by the binder-thresher method a crew of 4 or 5 men was required to cut and shock the grain and 11 to 13 to thresh it. In terms of machine-hours per acre (the actual time the combine or binder and thresher were operated) the binder-thresher method required 50 percent more time per acre than the combine. The total cost per acre of harvesting operations for the binder-thresher method was, by this comparison, a little less than twice as great on the average as the combine method of harvesting grain.

(1) Labor and men required to move the grain from field to bin in either case not included.

Most of the combine owners interviewed during the past winter were very well satisfied with the combine and believe that it will be a success in Ohio. They were asked to state the advantages and disadvantages of the combine. The following are some of the statements given. Advantages: (1) Lowers harvesting costs; (2) reduces harvest labor both in time and men; (3) allows more time for other things; (4) makes the farmer independent of exchange labor; (5) for grain farmers, it spreads the straw on the fields; (6) picks up down grain better than binder; (7) reduces cost and number of harvest meals. Disadvantages: (1) loss of straw; (2) large investment; (3) difficulty in handling green material; (4) uncertainty of the weather.

RELATION OF NET CASH RECEIPTS AND EXPENDITURE FOR FAMILY LIVING

C. E. LIVELY

The accompanying table shows the relation of expenditures for certain aspects of family living and the income of a group of 66 farm families who kept accounts during the calendar year 1927. "Net receipts" as used here means the net receipts from the farm business (gross receipts less current expenses) plus net receipts from all other sources. Thirty-seven of the families received some income from non-agricultural sources. This came mostly from miscellaneous earnings of the operator and homemaker altho returns on investments played a part. All were farmers, altho six had sufficient other income that they might be said to have had two occupations.

The average size of household did not vary much among the groups. It included all regular members of the family plus hired help which was kept for half of the year or more. The household size is more significant than the family size when the food item is considered, but less significant when other items are concerned. The average size family for the entire 66 families was 4.3 persons.

The high average expenditure of group one suggests that their income may not be habitually low, but that they possessed resources from previous more properous years. In fact inspection of the incomes of those families who have kept accounts for more

than one year shows this to be a fact. Apparently expenditure from year to year for living purposes is subject to less variation than income.

TABLE 1.—Relation of Net Cash Receipts and Expenditure for Certain Aspects of Family Living, for 66 Ohio Farm Families, 1927, by Income Groups

Income group (Net cash receipts)	Families in group	Average per family				
		Size of household	Total net cash receipts	Cash expended for living		Value of food furnished by farm
				All purposes	For food	
	No.	*No.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*
1. Under $1000	9	4.6	667	975	217	239
2. $1000 — 1499	15	4.1	1245	926	213	311
3. 1500 — 1999	13	4.6	1761	968	200	273
4. 2000 — 2499	13	4.3	2257	1213	241	309
5. 2500 — 3499	7	5.1	2911	1420	196	292
6. 3500 and over	9	5.1	4831	1772	305	304
All groups	66	4.6	2133	1165	227	290

There is a direct correlation between total expenditure for living and net cash receipts, but no significant correlation between net cash receipts and expenditure for food. The low expenditure for food in group five is due to the inclusion in the small group of two families which spent small amounts for food, having a large proportion furnished by the farm.

There is little relation between net cash receipts and the total value of food furnished by the farm.

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

Each of the first six months of 1929 showed a greater farm income from sales than the corresponding months of 1928. This greater income has been due mainly to more sales and better prices from the livestock industry. Sales from the poultry enterprise have been more than 20 percent greater than last year. Those from other livestock sales averaged 6 percent above the first six months of 1928. The decided drop in income in July 1928 was due to the wheat failure, a condition which does not prevail in 1929, hence there should be a continuation of the improvement.

Trend of Prices and Wages, 1910-1914=100

	Wholesale prices all commodities U. S.	Weekly earnings N. Y. state factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm products prices	Ohio cash income from sales
1913	102	...	100	100	104	100	105	104
1914	100	100	101	102	102	102	105	109
1915	103	101	106	100	103	107	106	109
1916	130	114	123	117	113	113	121	119
1917	181	129	150	176	140	119	182	191
1918	198	160	178	200	175	131	203	242
1919	210	185	205	209	204	135	218	268
1920	230	122	206	205	236	159	212	225
1921	150	203	156	116	164	134	132	129
1922	152	197	152	125	145	124	127	127
1923	156	214	153	135	166	122	134	137
1924	152	218	154	134	165	118	133	139
1925	161	223	159	146	165	110	159	147
1926	154	229	156	136	170	105	155	156
1927	149	231	154	131	173	99	147	144
1928	153	232	156	139	169	96	153	134
1927								
January	150	232	...	126	172	...	145	...
March	148	234	154	126	...	99	144	...
July	147	238	...	130	174	...	147	...
August	149	231	...	132	...	...	149	...
September	152	233	154	140	...	...	149	...
October	152	231	...	139	175	...	150	...
November	152	226	...	137	...	...	149	...
December	152	233	153	137	...	...	145	...
1928								
January	151	230	...	137	158	...	141	139
February	151	230	...	135	...	...	141	127
March	150	233	155	137	...	...	145	126
April	152	227	...	140	172	96	152	127
May	154	230	...	148	...	...	167	135
June	153	232	157	145	...	...	163	142
July	154	230	...	145	173	...	162	132
August	155	231	...	139	...	...	158	119
September	157	234	156	141	...	...	158	121
October	153	234	...	137	174	...	153	139
November	151	233	...	134	...	...	146	151
December	151	237	...	134	...	...	147	151
1929								
January	152	234	156	133	166	...	144	141
February	151	236	156	136	...	...	149	133
March	153	239	156	140	...	94	155	134
April	152	237	156	138	163	...	150	138
May	150	236	156	136	...	...	152	140
June	...	...	...	...	...	...	152	147

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WOOSTER, OHIO, U. S. A.

Free Bulletin

C. G. Williams

Director

NEW MONOGRAPH BULLETINS

PUBLISHED IN 1929 AND ANNOUNCED IN JULY-AUGUST BIMONTHLY

No. 430, The Normal Sprouting of Seed Potatoes.
No. 431, The Forty-Seventh Annual Report.
No. 432, Ohio Potato Diseases.
No. 433, Food Consumption of Farm Families.
No. 434, Fruit Varieties in Ohio, IV, Crab Apples.
No. 435, What Does It Cost to Grow a Bushel of Apples?
No. 436, The Nutritive Value of Blood Meal for Growth.
No. 437, Keeping Chickens in Confinement.

NOT PREVIOUSLY ANNOUNCED

No. 438, Losses in Shipping Ohio Livestock, Geo. F. Henning. This study of cripple and death losses of hogs, sheep, cattle, and calves in shipping was made at the Cleveland stockyards over the twelve-month period from October 1, 1926 to September 30, 1927, during which 13,704 cars arrived, carrying 118,709 cattle, 128,788 calves, 726,394 hogs, and 458,999 sheep, with an average loss per car of $4.15. The losses are carefully analyzed and classified as to cause and suggestions are made with the view to their possible reduction.

No. 439, The Culture of Greenhouse Chrysanthemums, W. W. Wiggin. This bulletin is a preliminary report of experiments with chrysanthemums now underway at the Station, on what varieties to grow and how to grow and handle them most successfully.

No. 440, The Truck and Its Relationship to Livestock Marketing in Ohio, Geo. F. Henning. The rapid growth of trucking and the influences affecting this method of transporting livestock to market are presented in this bulletin as an aid to those who are interested in economic livestock marketing.

No. 441, Organic Food Reserves in Relation to the Eradication of Canada Thistles, F. A. Welton, V. H. Morris, and A. J. Hartzler. Numerous chemical determinations of the amounts of food stored in different parts of the plants in experimental plots were made at intervals thruout the season as a basis for a study of economical eradication. "Systematic mowings made a month apart and continued thru four seasons removed practically all the thistles."

No. 442, Ohio Agricultural Statistics for 1928, by the Department of Rural Economics. This bulletin supercedes the Statistical number of the Official Bulletin formely published by the Department of Agriculture of Ohio.

No. 443, Farmers' Produce Markets in Ohio, Chas. W. Hauck. The history, facilities, management, and volume and nature of the business of the farmers' markets in Akron, Cleveland, Youngstown, Newark, and other cities of the State are presented in considerable detail in this study.

CHERRY LEAF SPOT CONTROL

H. C. YOUNG

Considerable doubt has developed recently in the minds of many cherry growers as to the efficacy of the standard spray schedule for the control of cherry leaf spot. There are seasons when the schedule results in perfect control and others when it partly fails. There is also a prevailing opinion that mild sprays and sulfur dusts will control the disease. Much of the confusion existing about the schedule to follow and the materials to use has been brought about by the peculiar or spasmodic occurrence of epidemics of the disease. In many sections cherries are rarely sprayed. In some sections there are seasons of practically no disease, which in turn may be followed by serious epidemics. This extreme variation has led many growers to regard the fungus as a weak parasite, which should be rather easily controlled.

Following a series of epidemics a demand was made by the cherry growers for more information on the control of this disease. The two points in question were, What materials to use? and When to use them?

In 1925 an extensive series of tests was made in the Highland Orchards at Bellevue. The experiment included comparisons between lime-sulfur, bordeaux mixture, mild sulfur sprays, and sulfur dusts. The results obtained were valueless in that less than 1 percent of leaf spot developed on the checks. The only point obtained was the extreme injury produced by bordeaux mixture.

The experiment was repeated in 1926 with practically the same results. All sprays and dusts controlled the very slight infection. Weak solutions of bordeaux (1-3-50) injured the foliage, and for this section its use is no longer recommended. At that time it was concluded that cherry leaf spot was not a serious problem in this orchard and the experiment was discontinued.

Consequently, in 1927 most of the cherry leaf spot control was attempted with dilute and mild sprays and sulfur dusts. The season was quite favorable for the fungus and a serious epidemic developed.

In 1928 the experiments were continued. Fifty 7-year-old Montmorency trees were used for each test. The dusted and sprayed plots were arranged alternately. The regular schedule of

four applications was followed. The first was at shucks fall, May 25; the second, June 7; the third, June 21; and the fourth, July 20. The materials used and the results are given in Table 1.

The main point obtained by the season's tests was that the mild sprays and sulfur dusts did not control cherry leaf spot. The lime-sulfur sprays were very efficient.

The experiment was continued in 1929. In the previous tests no attempt was made to time the applications either in relation to rain or the development of the fungus. It was thought that the sulfur dusts might possibly control leaf spot if they were applied ahead of rains and spore shooting.

A study of the fungus showed that the ascospores were mature much earlier than is normally expected. The first spray and dust applications were made May 8, before a rain. Poison was not

TABLE 1.—Dusting and Spraying Experiments for Control of Cherry Leaf Spot, Highland Orchard Co., 1928

Materials used	Percentage of infection		Percentage of defoliation
	June 28	July 6	September 1
Spray Lime-sulfur 1 gal. and 50 gal. of water Lead arsenate 1½ lb.	2.9	15.7	10
Dust Sulfur 80 lb. Dry lime-sulfur 10 lb. Lead arsenate 10 lb.	11.1	49.9	60
Spray Lime-sulfur 1 gal. and 50 gal. of water Lead arsenate 1½ lb.	1.7	3.9	5
Dust Sulfur 90 lb. Lead arsenate 10 lb.	12.5	42.4	60
Spray Lime-sulfur 1 gal. and 50 gal. of water Lead arsenate 1½ lb Caseinate ½ lb.	6.3	6.9	5
Dust Sulfur 75 lb. Dry lime-sulfur 15 lb. Lead arsenate 10 lb.	8.2	34.2	50
Spray Sulfuron 3¼ lb. and 50 gal. of water Lead arsenate 1½ lb.	8.4	30.2	30
Dust Kolotex	12.1	62.7	80
Dust Sulfur 89 lb. $KMnO_4$ 1 lb. Arsenate of lead 10 lb.	11.2	28.5	40
Spray Lime-sulfur 1 gal. and 50 gal. of water Lead arsenate 1½ lb.	1.9	2.4	5
Check	16.4	66.4	90

added, as many of the petals had not fallen. The second application was made May 15. In each case rain followed, and consequently a small shooting of spores. The bulk of the spores were discharged after the third application of June 4, the remaining three applications of spray were distributed thru the season as needed. Two additional dust applications were made following heavy rains. The materials used and results are given in Tables 2 and 3.

Cherry leaf spot was extremely difficult to control during the season of 1929. The weather in May, June, and early July was warm and rainy. The sulfur dusts were again wholly inefficient. The mild wettable spray "sulfuron" was better than the best dust, but it was much less effective than lime-sulfur. Possibly it could be used during seasons less favorable for the disease.

TABLE 2.—Dusting and Spraying Experiments for Control of Cherry Leaf Spot, Highland Orchard Co., 1929

Materials used	No. of applications	Percentage of infection		Percentage of defoliation	
		June 24	July 9	July 9	Sept. 10
Spray Lime-sulfur 1¼ gal. and 50 gal. of water Lead arsenate 1¼ lb.	6	4.5	4.5	11.0	20
Dust Sulfur 90 lb. Manganar 10 lb.	8	15.7	55.0	12.0	65
Spray Lime-sulfur 1¼ gal. and 50 gal. of water Lead arsenate 1¼ lb Aluminum hydrate 1 lb.	6	8.0	8.0	1.0	30
Dust Sulfur 75 lb. Dry lime-sulfur 15 lb. Arsenate of lead 10 lb.	8	11.6	72.0	12.0	65
Spray Lime-sulfur 1¼ gal. and 50 gal. of water Lead arsenate 1¼ lb. Ferrous sulfate ½ lb.	6	11.5	11.5	1.0	35
Dust Sulfur 65 lb. Koppers sulfur 25 lb. Arsenate of lead 10 lb.	8	17.0	67.5	12.0	65
Spray Lime-sulfur 1¼ gal. and 50 gal. of water Lead arsenate 1¼ lb. Aluminum sulfate 1 lb.	6	7.1	7.1	0.5	20
Dust Sulfur 90 lb. Lead arsenate 10 lb.	8	19.9	65.0	15.0	65
Spray Sulfuron 5 lb. and 50 gal. of water Lead arsenate 1¼ lb.	6	24.2	31.1	5.0	50
Dust Kolotex	8	33.1	96.0	30.0	85
Check	0	33.0	100.0	85.0	100

TABLE 3.—The Timing of Cherry Leaf Spot Sprays

Material used	No. of sprays	Percentage of infection		Percentage of defoliation	
		June 24	July 9	July 9	Sept. 10
Lime-sulfur 1¼ gal. and 50 gal. of water.. Arsenate of lead 1¼ lb...............	All six applications	4.5	4.5	0.1	20
Lime-sulfur 1¼ gal. and 50 gal. of water.. Arsenate of lead 1¼ lb....................	Five applications No. 1 omitted	... .	8.5	.5	23
Lime-sulfur 1¼ gal. and 50 gal. of water.. Arsenate of lead 1¼ lb....................	Four applications	....	20.6	3.0	40

These preliminary results show also that the cherry leaf spot fungus infection period can be timed, much as with apple scab. This season it paid to make a pre-shucks fall application.

SUMMARY AND RECOMMENDATIONS

1. Lime-sulfur, 1¼ gallons to 50 gallons of water, is a safe and effective spray for the control of cherry leaf spot. The schedule of application should be governed by the development of the fungus. In the absence of such information the grower would do well to make the first application at petal fall instead of shucks fall. Foliage should then be kept covered. An application every two or three weeks should be sufficient.

2. Sulfur dusts are ineffective in this location. Preliminary tests indicate that dusts do not stick to cherry foliage sufficiently to control the disease. In this experiment the best dusts known were tried.

3. Bordeaux mixture caused severe foliage injury in this section. Its use is not advised.

4. A more detailed study of the fungus is being made and a general summary of the work will be published in bulletin form later.

HOW LONG SHOULD HOLSTEIN CALVES RECEIVE MILK?

CHAS. H. CRAWFORD AND W. E. KRAUSS

In the highly specialized whole-milk districts there are two factors that are often responsible for small, unthrifty, and undernourished heifers: as calves they are fed an insufficient amount of milk at a feeding, and they are often fed milk for too short a time. Undernourished calves may not mature into as good individuals as they would had they been properly fed. This naturally reverts to the owner in the form of a monetary loss, because of lower production. This then is a problem of considerable importance and affects every dairyman who raises calves.

The feeding experiments with powdered skimmilk at the Trumbull County Experiment Farm, the results of which were reported in the March-April, 1929, Bimonthly Bulletin, were continued.* Holstein heifer calves were fed milk for different periods of time. The object was to determine the minimum requirement of the calf insofar as the length of the milk-feeding period is concerned.

Eight Holstein heifer calves were used in this experiment. They were divided into three lots. Lot 6 received milk for 60 days, Lot 7 for 90 days, and Lot 8 for 120 days. One calf in each lot was fed farm-separated skimmilk, one remixed powdered skimmilk, and another, except in Lot 6, dry powdered skimmilk. No calf in Lot 6 was fed by the dry powder method because of the fact that ordinarily calves do not take all of their milk in the dry form until after they are sixty days old. The change from whole-milk to either remixed skimmilk or farm-separated skimmilk, depending on how the calf was fed, was complete by the time the calf was three weeks old.

Each calf while fed milk was allowed all the grain she would consume up to three pounds daily. When milk was discontinued the grain allowance was increased to four pounds a day. The grain mixture was composed of 100 pounds of ground corn, 100 pounds of ground oats, 100 pounds of wheat bran, 50 pounds of linseed oilmeal, and 3/4 pound of salt. The calves were given all of a good

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*Credit is due S. M. Salisbury and C. L. Blackman, of the Ohio State University, for suggestions and help in this work and also that previously reported in the March-April Bimonthly Bulletin, on Powdered Skimmilk as a Feed for Dairy Calves.

quality mixed hay they would eat, and an accurate record was kept of the amount consumed by each calf. During the day the calves were kept in the barn, and at night they were turned into a dry-lot for exercise. Water was provided at all times.

The experiment was planned so that the effect of feeding the farm-separated skimmilk, remixed skimmilk, and dry skimmilk might be studied also when each was fed for different lengths of time.

Table 1 shows the amount and cost of feed consumed by each lot until the calves were six months old.

TABLE 1.—Amount of Skimmilk (liquid basis), Hay, and Grain Consumed, Gain in Weight and the Cost of Feed per Calf Until 180 Days Old

Lot	Method of feeding skimmilk	Calf No.	Milk	Grain	Hay	Total gain	Cost of feed	Average cost of feed
			Lb.	*Lb.*	*Lb.*	*Lb.*	*Dol.*	*Dol.*
6 Fed milk for 60 days	Farm-separated	1 A	735	380	381	238	15.52	16.61
	Remixed	2 A	760	406	363	244	17.71	
7 Fed milk for 90 days	Farm-separated	3 A*	....	....	....	....	....	21.05
	Remixed	4 A	1071	389	341	259	19.91	
	Dry powder	5 A	1442	334	536	285	22.20	
8 Fed milk for 120 days	Farm-separated	6 A	2038	266	578	301	23.17	27.59
	Remixed	7 A	2043	285	590	285	27.45	
	Dry powder	8 A	2375	326	558	295	32.15	

*Taken off experiment because of sickness.

As was to be expected, Table 1 shows that the cost of feed and the total gain increased with the length of the milk-feeding period. The calf in each lot that, after sixty days, received all its milk in the dry form, consumed more milk in the given time than any other calf in the respective lot. The consumption of hay was approximately in proportion to the amount of milk consumed, and therefore in direct proportion to the total gain of the calf. Whether this was related to the milk consumption directly or to increased

TABLE 2.—Showing the Normal Weight for Calves of Different Ages, the Average Weight of Calves in Each Lot and the Gain in Weight per Calf for Each Three-month Period

Age	Normal weight (Eckles)	Lot 6		Lot 7		Lot 8	
		Weight	Gain	Weight	Gain	Weight	Gain
Months	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Birth	90	98	....	106	....	104	....
3	200	205	107	231	125	242	138
6	349	339	133	378	147	398	156
9	466	467	128	505	127	526	128
12	558	587	120	617	112	627	101
15	612	694	107	753	136	773	146

capacity due to greater size cannot be stated. That the increased consumption of hay was beneficial is probable in view of the important factors found in hay that promote growth and well-being.

The composite curves of the calves in each group, Figure 1, show strikingly the relationship between the length of the milk-feeding periods and the rate of growth to 180 days. The calves receiving dry skimmilk powder withstood the removal of milk from the ration better than did those receiving liquid milk.

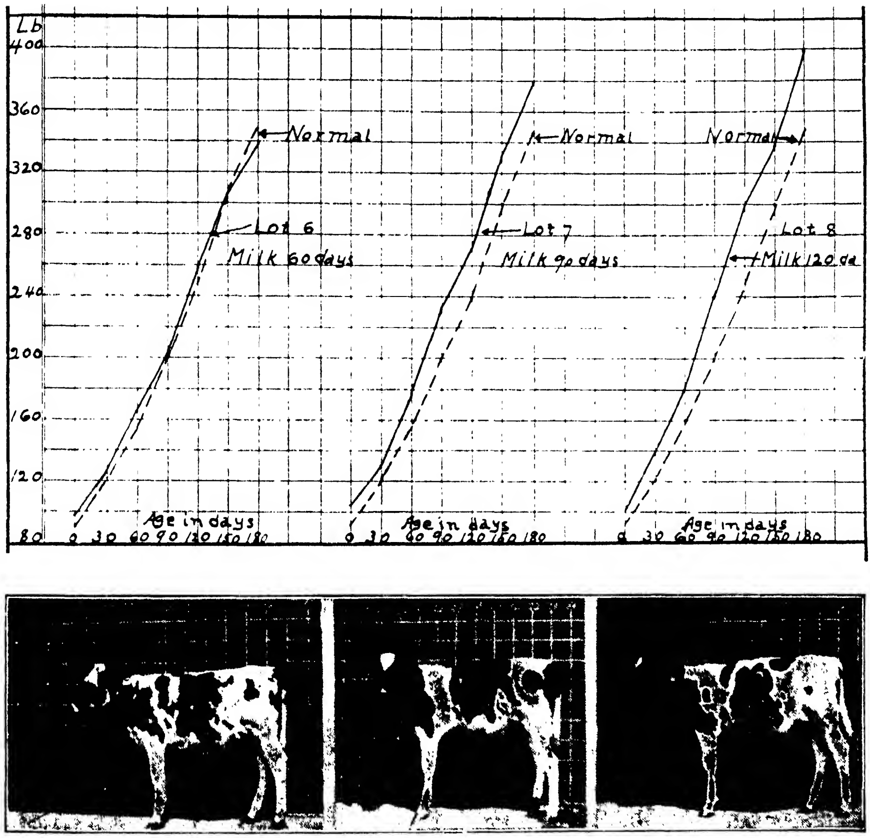


Fig. 1.—2A, Lot 6, remixed skimmilk 60 days, gain 244 lb.
4A, Lot 7, remixed skimmilk 90 days, gain 259 lb.
7A, Lot 8, remixed skimmilk 120 days, gain 285 lb.

Will calves that are deprived of milk at the age of 60, 90, or 120 days mature into well-grown normal cows?

Is the small saving which is made by depriving the calf of milk at an early age justified?

In order to answer these questions and for the purpose of studying the effect of feeding calves milk for different length periods, an average of all calves in each lot was used. By so doing the use of the three different methods of feeding milk to the calves eliminated any advantage or disadvantage of any particular method of feeding.

Tables 2, 3, and 4 give the weight, the gain in weight, and the skeletal development of the calves in the different lots by three-month periods until they were fifteen months old. Records will be continued until after their first freshening.

TABLE 3.—Skeletal Development as Indicated by Height at the Withers

Age	Height at withers			
	Normal (Eckles)	Lot 6	Lot 7	Lot 8
Months	*In.*	*In.*	*In.*	*In.*
Birth	28.27	29.62	31.08	30.50
3	34.17	34.27	35.62	36.16
6	39.72	38.75	40.12	40.75
9	42.95	42.87	44.00	44.08
12	44.88	45.37	47.12	47.16
15	46.77	46.25	48.87	48.91

These tables show that the calves in Lot 6 at six months of age were below normal in both weight and height, while those in Lots 7 and 8 were 8.9 percent and 14 percent, respectively, above normal in weight, and 1.6 percent and 2.5 percent above normal in height. At one year of age all calves were above normal in weight and height. At 15 months all were considerably above normal in weight, but those in Lot 6 were 98.8 percent of normal in skeletal growth. If we compare the rate of gain in weight, Table 4, for the last three-month period, we find that Lot 6 gained 8.2 percent; Lot 7, 12.5 percent; and Lot 8, 14 percent. This shows that, altho Lot 6 was 13.3 percent and Lots 7 and 8 were 23 percent and 26.3 percent, respectively, above normal weight, the rate of gain was still in proportion to the length of the milk-feeding period.

TABLE 4.—Weight, Height, and Gain Compared to Normal (Eckles)

Age	Lot 6			Lot 7			Lot 8		
	Weight	Height	Gain	Weight	Height	Gain	Weight	Height	Gain
Months	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Birth	108.8	104.7	....	106.0	109.0	....	104.0	107.8	....
3	102.7	100.2	97.7	115.5	104.2	113.6	101.0	105.8	125.4
6	97.1	97.5	93.0	108.9	101.6	105.0	114.0	102.5	113.5
9	100.2	99.8	97.8	108.3	102.4	106.1	112.8	102.6	112.2
12	105.1	102.4	104.4	110.5	104.9	109.1	112.3	105.0	111.7
15	113.3	98.8	114.1	123.0	104.4	123.9	126.3	104.5	128.1

The Minnesota Experiment Station found that calves weaned at from 50 to 72 days slowed up in growth after weaning. This was not overcome by the time they were 180 days old. However, the rate of growth increased near the end of the 180-day period, and continued for some time so that when the calves reached two years they were above normal in weight.

From the foregoing data kept on only a small number of calves until fifteen months old, no very definite conclusions can be drawn. A few lessons may be had from this study, however:

1. If it is necessary to deprive Holstein calves of milk at the early age of 60 days, they may be expected to mature into heifers that are practically normal in weight and skeletal growth provided they are fed and cared for properly after they no longer receive milk.

2. Calves fed milk for 90 and 120 days are able to consume more hay than calves fed milk for only 60 days. Thus they are better able to continue their rapid rate of growth and remain above normal in weight and skeletal growth.

3. That it is wise to save money by depriving heifer calves of milk at the age of 60 days is doubtful.

4. Under ordinary herd conditions it would probably be poor economy to feed calves milk for more than 120 days.

5. Weaning had less effect on calves that received their milk mixed dry with the grain.

6. The health, size, and vigor of the calf as well as weather conditions and housing, may have an influence on the proper length of the milk-feeding period.

SODIUM CHLORATE AS A LAWN WEED KILLER

F. A. WELTON

Ground ivy, or gill-over-the-ground *(Glecoma hederacea)* is a common weed found on many lawns. This is a perennial plant, with creeping stems, round, kidney-shaped, scalloped leaves, and reddish blue flowers. The stems contain many joints at which roots develop. The character of growth of ground ivy is indicated in Figure 1. Under close clipping this creeping plant thrives, and in many cases, occupies the ground to the almost complete exclusion of desirable grasses, as shown in Figure 2. It flourishes in shady places, and when the ground is not mowed often covers the ground completely. On account of its trailing habit of growth, the plants become so entwined with the grass that eradication by digging it up, even on small areas, without destruction of the grass is next to impossible. For years this plant has been rated as one of those obnoxious lawn weeds with which one must learn to live rather than to entertain hope of its extermination.

At last, however, a simple and effective remedy has been found by means of which ground ivy can be easily destroyed. This consists of a single spraying with sodium chlorate, using 1 to 2 ounces per gallon of water, and that quantity of solution is sufficient to cover 100 square feet, providing a pressure sprayer is used. If applied with a sprinkling can, a trifle more solution will be needed, as that method of application is somewhat wasteful of material. The leaves should be thoroly covered. The spray can be applied any time during the summer or fall. Since the spray discolors the grass for a short time, it is perhaps best to defer application until fall, say, the first of November.

Altho applied in the strength mentioned, the chlorate does not kill the grass, yet, if the ground ivy has become densely matted, the stand of grass will, of course, be thin and the soil should, therefore, be fertilized and reseeded. This may well be done the following spring, sometime in March when the ground is honeycombed by frost, depending on subsequent freezing and thawing to cover the seeds. A 4-12-4 or other high grade fertilizer should be applied a week or so in advance of seeding. An area thus fertilized and reseeded after spraying to kill ground ivy is shown in Figure 2.

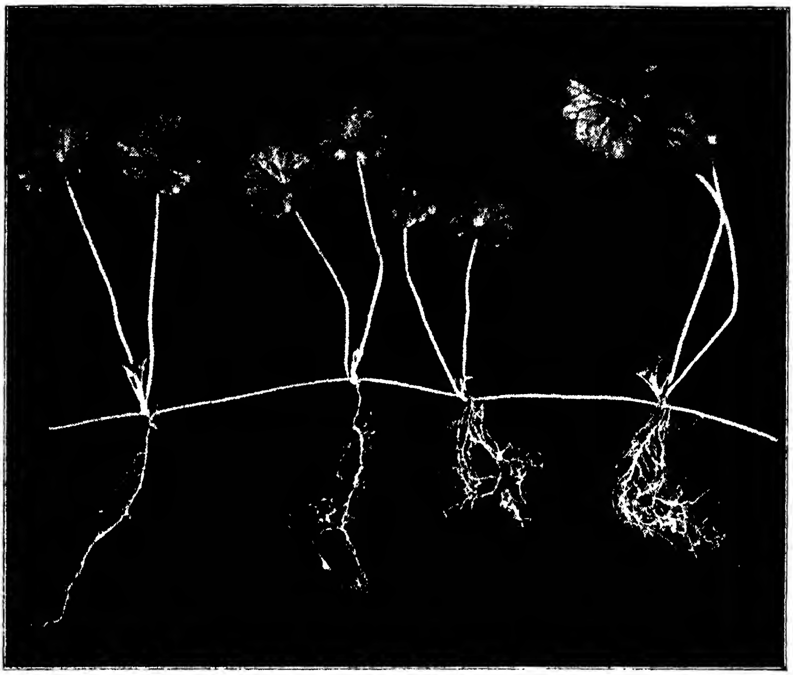


Fig. 1.—Ground ivy, or gill-over-the-ground, showing nature of growth

Fig. 2.—Spraying to kill ground ivy—left, unsprayed; right, sprayed with sodium chlorate and reseeded

Speedwell.—Another weed often found in parks and lawns is thyme-leaved speedwell *(Veronica serpyllifolia)*. This is a perennial with slender, decumbent branching stems opposite leaves and small white or bluish flowers borne in clusters at the end of the stems. The habit of growth including the development of roots is illustrated in Figure 3.

Fig. 3.—Speedwell, a weed often found in parks and lawns, showing habit of growth and development of roots

When closely clipped, the plant forms a dense mat, usually circular in form, and often two or three feet in diameter. Sometimes considerable areas are covered almost to the complete exclusion of lawn grasses.

Thyme-leaved speedwell yields to sodium chlorate, and the solution may be applied at the same time and in the same strength and manner as directed for ground ivy. Since a mat of speedwell inhibits the growth of grass, the ground will necessarily be practically bare after the speedwell is killed. Consequently it will be necessary to fertilizer and reseed. This also can be done the same as directed for ground ivy.

THE RELATION OF SIZE OF SEEDLING TREES TO THEIR VIGOR

R. B. PATON

INTRODUCTION

Forest planting stock of coniferous species ordinarily is raised in seed beds where the seed is broadcast. This method of growing the young trees produces considerable variation in the size of the individuals due to crowding, and many of the seedlings are very small as a result.

The question arises then as to the relative vigor of these small trees as compared with the medium sized or large trees in the same seed beds. If these small trees are small because of late germination only, they will recover their normal growth rate upon being released from the overtopping larger trees, but, on the other hand, if their size is a measure of their vigor they will always be lagging behind those that became dominant the first two years. If this latter possibility be the true explanation, grading of the planting stock is advisable.

AN EXPERIMENT

During the month of April 1927, seedlings of Corsican pine, Scotch pine, white pine, Norway spruce, and white spruce were selected from the two-year old seed beds. Trees were chosen from the upper, middle, and lower height classes, each tree numbered with an aluminum tag, and then transplanted into rows 8 inches apart and 2 inches apart in the rows. Their heights were measured at that time, the following autumn, and the autumn of the succeeding year, that is 1928. In April 1929, the trees were lifted and set out permanently in a field covered with a light sod of poverty grass and cinquefoil. The following September they were remeasured, heights being taken both at the top of the current year's growth and at the top of the previous year's growth. In this way the difference in depth of planting of the trees could be measured by comparing this reading with the heights as read for the preceding September, and this difference adjusted in the final data.

The trees were originally measured to the nearest half inch and in the analysis of the data they were grouped by species, and

by half-inch height classes. They were then regrouped, still separated by species into three height classes, based on the original height, each class to contain an equal number of half-inch classes. The white spruce was the only species which did not contain the same number of half-inch classes in the three groups. The upper and lower groups each had six classes and the middle group five. This is unimportant however.

The data found are summarized in the following table:

Table Showing Height Growth and Survival Percentage of Five Coniferous Species

Size class (sizes inclusive)	Trees planted	Average height of each group on the following dates				Average survival
		April 1927	Sept. 1927	Sept. 1928	Sept. 1929	
In.	No.	In.	In.	In.	In.	Pct.
			Corsican pine			
5.0-4.0............	16	4.2	6.1	12.9	17.1	87.5
3.5-2.5............	18	2.9	4.3	10.1	13.5	88.8
2.0-1.0............	9	1.9	3.6	8.1	10.2	66.7
			Scotch pine			
9.0-7.0............	7	7.7	10.7	18.2	25.6	100.0
3.5-4.5............	14	4.8	8.3	15.9	23.4	85.7
4.0-2.0............	26	3.5	5.9	12.7	17.7	92.5
			White pine			
3.5-3.0............	7	3.2	4.5	5.7	7.6	28.6
2.5-2.0............	12	2.1	3.1	9.0	7.2	41.7
1.5-1.0............	24	1.4	2.6	5.0	5.9	33.3
			Norway spruce			
5.0-4.0............	16	9.2	12.8	21.4	25.6	85.7
3.5-2.5............	18	6.1	9.2	18.4	20.7	88.0
2.0-1.0............	9	3.7	6.1	12.4	15.7	80.9
			White spruce			
9.0-6.5............	9	7.3	10.6	15.3	17.0	88.9
6.0-4.0............	25	4.7	7.1	12.0	14.3	96.0
3.5-1.0............	23	3.0	5.1	9.1	10.9	87.0

The data are also shown graphically by the accompanying curves.

In four of the five species the smaller size trees had a lower rate of growth than the middle or upper groups. The exception was white pine. In this species, the lower group maintained about the same difference in height below the upper group as it had when originally measured. This species suffered such a high mortality, however, that only a few trees survived and the data consequently

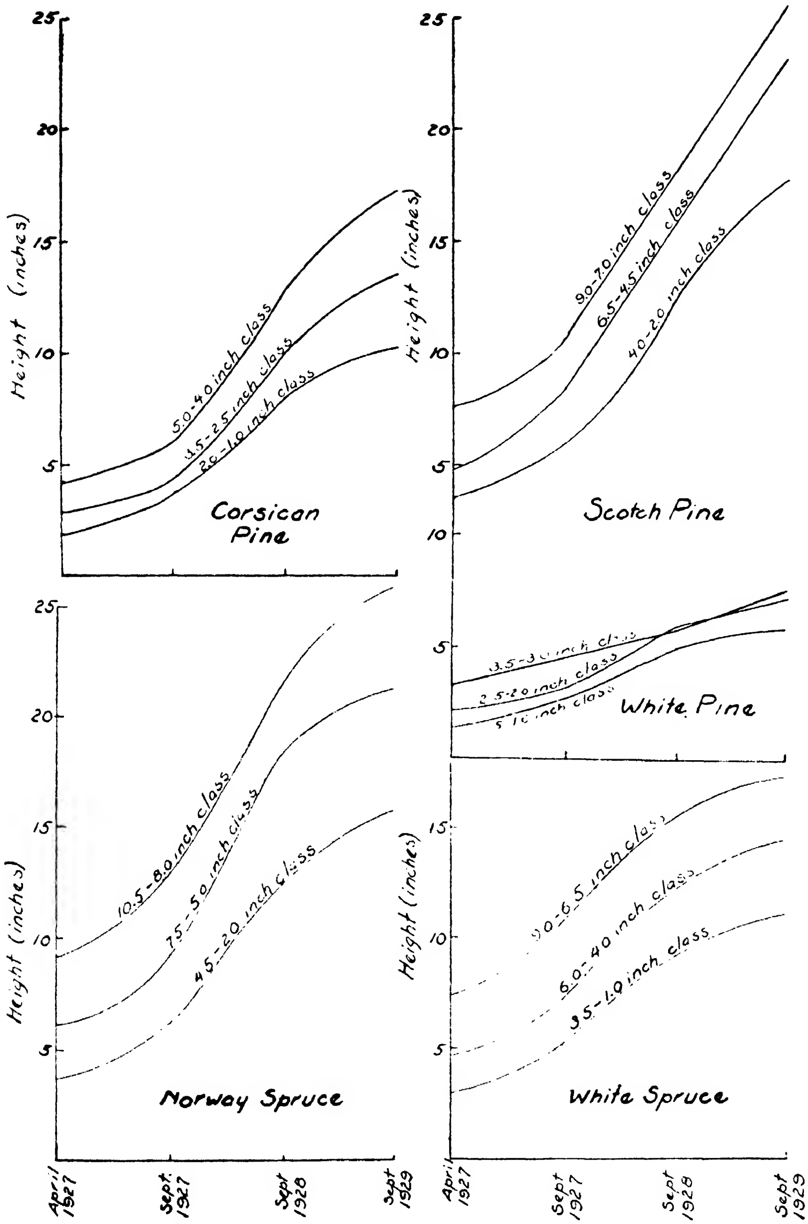


Fig. 1.—Showing relative height growth of the three classes of seedlings

are less conclusive. The other species had definitely faster growth rates in the middle and upper groups. In connection with this, another fact is brought out. The lower group was affected considerably more than the other two groups by transplanting into the permanent site. The upper group showed little reduction in growth rate following transplanting; the middle group, somewhat more; and the lower group, the greatest effect. The middle group of Norway spruce was the only exception in this.

The middle group showed the highest survival in each species excepting the Scotch pine, in which case the upper group had the greatest survival percentage. However, the differences between the groups were hardly great enough to be considered.

CONCLUSION

The smallest trees in the seed beds of the coniferous species studied were small because of inherent lack of vigor and probably will always be weaker than the trees in the middle or upper groups. This is shown by their slower growth rate and their somewhat lower survival percentage. These small trees were affected more by transplanting into the final location than the other trees. This gave them an added handicap.

The advisability of grading nursery stock cannot be stated from these results. Undoubtedly, the small trees, being weaklings, are less desirable than the larger ones, but the use of each class of trees in a forest plantation, that is, dominant, codominant, intermediate, and suppressed, should not lessen the ultimate timber yield and the smaller trees in the stand would tend to prevent stagnation in growth that would obtain in unthinned stands of equal height and crown class.

ALL-NIGHT LIGHTS FOR WINTER LAYERS

D. C. KENNARD

The use of artificial light in poultry houses to encourage winter egg production has become an established practice of recognized merit. There have been three methods for use of lights—evening, evening lunch, and morning lights. Each has its advocates and its advantages and disadvantages. The purpose of this article is to consider a fourth method—all-night lights for layers.

THE INTRODUCTION OF ALL-NIGHT LIGHT FOR LAYERS

Discoveries and contributions often result by chance, accident, or from necessity. A typical instance of this is the use of all-night lights for winter layers. It seems this new practice was initiated in southeastern Ohio, when J. E. Morris disregarded the precautions generally observed in the use of light for layers. He desired to use natural gas for lighting the poultry house. The difficulty was in automatically turning the light on and off. He solved this problem by leaving the light on all night. This was in the fall of 1925, and each year since, Mr. Morris, guided by his first-hand experience, has used all-night light for his hens with satisfactory results.

His practice was to put the hens in their winter quarters about October 1, and start the all-night light around November 1. Each year the hens averaged 10 to 12 percent production when the light was started, after which there was a prompt increase of production to 40 to 50 percent, which was maintained during the winter months. He observed that not more than 15 to 20 percent of the birds were off the roosts at any one time during the night, and that they drank about one-half as much water at night as during the day, but they ate much less. The light for 200 hens in a pen 25 by 24 feet was supplied by one inverted gas mantle. This made a dim light comparable to a 15-watt electric bulb.

The success of Mr. Morris with all-night light for the hens was followed by that of others in his locality, who have reported similar results. While some of the poultrymen reported favorably on this method of lighting for pullets, its success has been demonstrated for the most part with hens. Furthermore, it should be remembered that those who succeeded with all-night light for the layers were successful poultrymen, who have good housing and

equipment, and exercise skill in feeding and managing their flocks. Failure from other causes will not be prevented by all-night light, nor any other method of using light. The chain that leads to success in winter egg production is made up of many links, any one of which may cause failure.

The question of all-night light for winter layers, and its demonstrated success by poultrymen in southeastern Ohio, was first brought to the attention of the Station, November 22, 1928, by Arthur H. Smith, County Agent of Monroe County, Ohio. The Station immediately started all-night light on several groups of pullets, which responded promptly with an increase of production. This was well maintained during the winter months without any ill effects from using light over time.

Following this favorable experience at the Station with all-night light for pullets, Mr. Smith was invited to appear on the Station's Poultry Day program, June 20, 1929, to discuss this method of lighting as he had observed in it actual practice among some of the progressive poultrymen in southeastern Ohio. Mr. Smith's discussion of this new departure in the use of lights was received with keen interest by Poultry Day visitors. He presented the subject in a conservative way, and emphasized the fact that it was all quite new, and substantiated by little or no experimental evidence. However, he had observed the successful demonstration of the use of all-night light by different poultrymen during the past four years, and in no case had any of the supposed ill effects of overtime light been experienced. On the contrary, it appears that each of the poultrymen who tried this method of lighting has adopted the practice. Some of the high points brought out in Mr. Smith's discussion were as follows:

The practice was to use the all-night light for hens rather than pullets. However, instances of its successful use on pullets were cited. The hens were put into winter quarters about October 1, when they were molting and in low production. The all-night light was started about November 1, with the result that the hens responded promptly with increased production, which was maintained during the winter months. Heavy grain feeding at night was practiced. (The writer suggests that this can be accomplished by feeding the grain in mash feeder on top of the mash, so the birds could easily find it in the dim light.) Warm water should be available during the night so the birds can drink at any time.

A dim light serves the purpose. If electricity is used, a 15 watt bulb will serve 100 layers, and a 25 watt bulb 200. The light

is located over mash feeders and water. It does not need to be shielded from the roosts. In fact, sufficient light is needed on roosts to enable the birds to get back and forth from water and feed. The lights are usually discontinued in April or May.

ALL-NIGHT FOR PULLETS

All-night light was used on Leghorn pullets of different ages and quality at the Station. Three groups, each of 40 backward, rather inferior pullets, received the same ration and management, except that a different kind of floor litter was used in each pen. The three groups averaged 19 percent egg production when lights were started, 39 percent two weeks later, and 57 percent after four weeks. They laid 49 eggs per bird from December 1 to March 1. The mortality to June 15 was 12.5 percent. The pullets received an all-mash ration, part of which was fed moistened.

At the same time a fourth group of better quality, more mature pullets was given all-night light. These pullets were in 40 percent production before receiving the light. In two weeks their production increased to 65 percent, and in four weeks to 75 percent. These pullets averaged 57 eggs each from December 1 to March 1, with a mortality of 12.5 percent.

In another test 24 January hatched pullets were laying 45 percent when they were moved from range, July 15. Loss of egg production, and a molt followed. It was necessary to change these pullets to other quarters again October 1. After which, and until they received all-night light, only two continued to lay. December 7, two weeks after receiving the light, practically all the birds had started laying. Their production averaged 63 percent from this date to April 1, when the light was discontinued. Mortality to June 15 was 16 percent.

The foregoing results are simply demonstrative, and are in no sense experimental evidence to indicate the merits of all-night light for laying pullets. Similar response likely would have been obtained had any other method of lighting been employed. The point is, that in each instance a remarkably prompt response in increased egg production resulted, and was well maintained until the lights were discontinued April 1. No ill effects from the overtime use of the lights were observed. The Station is conducting carefully controlled experiments this winter to secure further information as to all-night light for pullets and hens.

It seems that all-night light for layers may be used to advantage in certain cases, especially for hens, intended for market

egg production, or hatching eggs in December and January. Backward pullets may also be hastened into production. When other efforts fail, perhaps all-night light may be worth a trial. When gas or lanterns are used for lighting the laying house, all-night light is a simple solution of the difficulty of automatically turning the lights on and off. When more experience and information become available as to the special uses of all-night light for layers, undoubtedly this method will find its place along with the other methods as an established practice.

SECTIONAL WALL NESTS

D. C. KENNARD

Suitable nests and plenty of them are a necessary part of the equipment of every laying house. There should be 20 to 25 nests for each 100 layers.

Nests to be most satisfactory and practicable should not be located or constructed so as to afford a harbor for mites and lice. They should be simple in construction, inexpensive, easily removed for cleaning, easy to clean, well ventilated, cool ,and equipped with wire bottoms so as to be practically self-cleaning. The sectional wall nest to be described was designed by the Ohio Station to meet these qualifications.

The plan and photograph, Figures 1 and 2, show a top and lower section of four nests each. The sections can be made longer for five to eight nests, according to wall space available. One, two, or three tiers of nests are used according to the number of layers to be accommodated. The top section has a sloped top to prevent the birds from roosting on it. The lower sections are flat on top so that other sections may set on them. The bottom section is supported by a spike in the wall, and is held in place by a 2-inch screen door hook and eye.

The stand board serves as an approach for the hens to enter nests, and is hinged so that it can be turned up to keep the birds out when desired. It will be observed from the detail of stand board that the butt end of hinge is screwed to inside of nest. This mode of attachment with the two 1 by 1 inch blocks beneath stand board, with direct end thrust against side of nest, makes a strong support. This attachment also swings stand board into proper

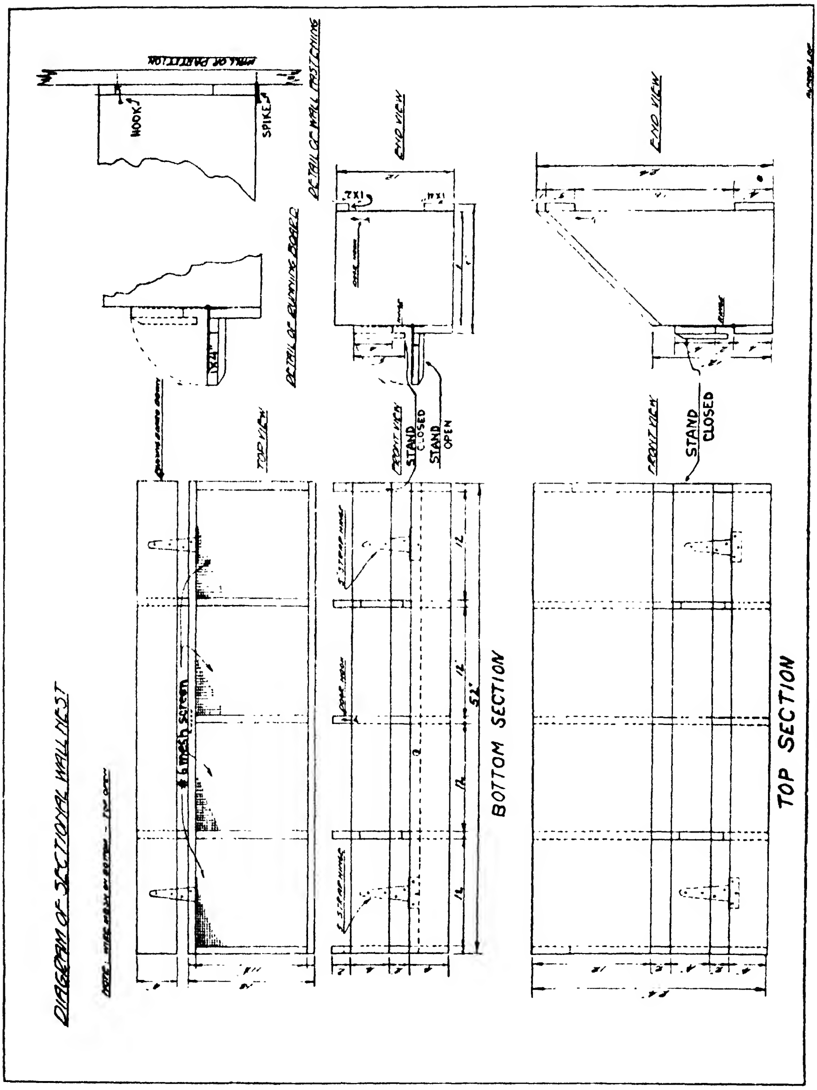
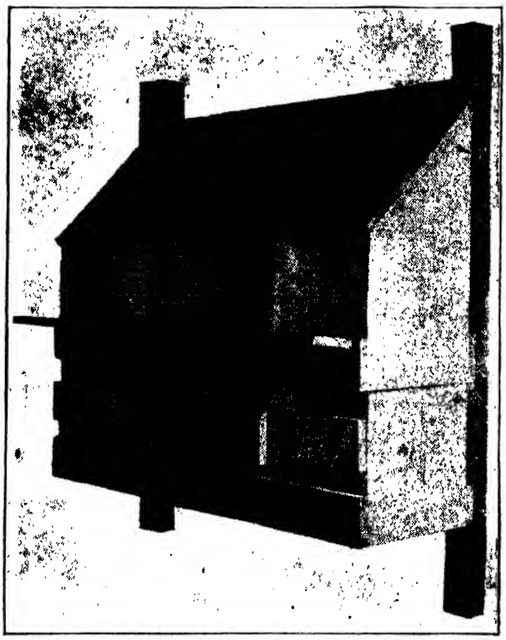


Fig. 1.—Diagrams showing construction of wall nests

position above when closing entrance openings to the nests. This is further accomplished by attaching stand board to the 5-inch tee hinge so that there is about $1\frac{1}{2}$ inches of space between inner edge of stand board and the front side board inclosing the nests. This and the position of the supporting blocks under stand board are clearly indicated in the diagram.

The bottoms of nests are made of No. 6 mesh hardware cloth, securely attached by small staples. Some poultrymen may prefer No. 4 mesh when coarse straw or the like is used for nesting material. The wire bottoms are desirable because they are largely self-cleaning, offer little harbor for parasites, and make the nests cool in summer. The dust or fine material sifting thru from one tier of nests to another below, is in no way objectionable. These siftings have no ill effect on the hens' back, nor do they soil the eggs in case they are not covered by a hen.



Wall nests

The sectional wall nests are easy to remove and replace, since each section can be handled separately. They have the advantage of being flexible as to number of nests desired at any given time. Sometimes but one section is needed. At other times it may become desirable to add sections so as to have three tiers, one above another. Furthermore, sectional nests are easily transferred from one house to another. Wall nests may be located on walls, partitions, or a simple frame work may be erected when sufficient wall or partition space is not available. Usually it is not desirable to locate the nests too near the front of the house, because of excess light and exposure to drafts in winter. In many poultry houses there is a suitable wall or partition space for nests just in front of the

droppings boards. Nests should never be put under the droppings boards. Such nests are a nuisance for two reasons: they make the space under the boards inaccessible for cleaning and other purposes, and nests under droppings boards are a menace because of the harbor they offer for mites and other parasites.

BILL OF MATERIAL

One lower section of 4 nests, 12 " x 12 ", for light breeds

Partitions 5—1 " x 12 "—1 ft. long

Side nest inclosures and stand board 3—1 " x 4 "—4′ 4 " long,

Cleat across top and back of partitions 1—1 " x 2 "—4′ 4 " long

2—5 " tee hinges

1 piece No. 6 mesh hardware cloth 14 " x 54 "

One top section of 4 nests, 12 " x 12 ", for light breeds

Partitions 3—1 " x 12 "—3 ft. long

(Each cuts diagonally to make two partitions)

Cover boards for top section

1—1 " x 12 "—4′ 4 " long

1—1 " x 6 "—4′ 4 " long

Side nest inclosures and stand board

3—1 " x 4 "—4′ 4 " long

Cleat across top and back of partitions

1—1 " x 3 "—4′ 4 " long

2—5 " tee hinges

1 piece No. 6 mesh hardware cloth 14 " x 54 "

When nests are made 12″ x 14″ for larger breeds, or when the number of nests to the section is increased, it will be necessary to make a corresponding change in the bill of material.

PACKING OF OHIO APPLES IN BOXES

CHAS. W HAUCK

The packing of apples in boxes is customary in all of the western apple growing sections, but in Ohio the practice is in its infancy. The established trade in apples has long been accustomed to eastern fruit packed in barrels and in bushel baskets. The wholesale trade, due to the generally lower standards of grade and pack in the east, has not encouraged the packing of apples in boxes. The feeling has been that boxes should be reserved for a high-class product which could be offered to a special trade at a premium price.

An effort was made during the season of 1928 to learn whether profits to Ohio growers might be increased by substituting the box for other types of packages in the packing of high grade apples. Thru the cooperation of the Chesapeake Orchard Company in Lawrence County, the Rural Economics Department of the Ohio Agricultural Experiment Station, and the Horticultural Extension Department of the Ohio State University, one carload of Rome Beauty apples was packed experimentally in boxes and the costs and returns compared with those of similar fruit packed in bushel baskets.

The fruit was graded to the requirements of U. S. No. 1 grade specifications, the apples being well formed, practically free from defects, and with a minimum of 15 percent good color for the variety. The apples were fairly well colored thruout, but were not unusually high in color. Each apple was wrapped in oiled tissue paper and the standard arrangement in the boxes was followed. No apples smaller than 3 inches in diameter were packed in this manner. All the fruit fell into one or the other of the following sizes: 64, 72, 80, 88, 96, and 104.

The boxes were made locally from native basswood and poplar, according to the specifications of the western box, namely, 18 inches long, 11½ inches wide, and 10½ inches deep, inside measurements.

Careful records were kept so that a direct comparison might be made between boxes and baskets, item by item. These expenses are given in the accompanying table.

Cost of Packing Apples in Baskets and in Boxes

	Baskets	Box
	Dol.	*Dol.*
Grading and packing, including labor and machinery costs	0.07	0.11
Packages, made up and delivered at packing house	.20	.26
Liners, pads, etc.	.02½	....
Oiled wrapping paper	....	.06
Shredded oiled paper	.10	....
Total grading and packing costs	.39	.43
Hauling, packing house to storage	.04	.02¼
Cold storage for season	.30½	.30
Total costs	.73½	.75¼

The fruit was placed in cold storage immediately after packing and was sold out gradually during the winter in small lots to nearby retailers and fruit stands. A few lots were sold to retailers in the West Virginia coal fields. The wholesale selling price on 646 boxes averaged $2.466 per box. The same grade of fruit packed in bushel

baskets sold to the same trade and during the same period at an average of $1.725 per basket. The net weight of apples was practically the same in both types of packages. The quality and size of the fruit was identical. All the fruit came from the one orchard and was graded over the one grader by the same crew. Part of the fruit from the No. 1 bins was used for boxing and the remainder was packed in baskets, both operations being carried on simultaneously. Both lots were stored in the same storage house and sales were made in the same manner to the same class of trade. The comparison, therefore, is a fair one and discloses a net premium of $0.721 per box.

The experiment is being continued and expanded in the 1929 season. About 1700 boxes have been packed and placed in storage. Part of these will be sold as before and part of the boxes will be shipped out by rail to one of the large receiving markets, where they will be sold in competition with fruit from the same orchard in bushel baskets, and where they will have to face also the competition of boxed apples from the west. The results of the experiment will be reported later.

AUTUMN LEAVES

WEEKLY PRESS BULLETIN

The brilliant colors of autumn leaves are due to changes in the green, red, and yellow pigments of the leaf and serve a purpose in aiding the plant to adjust itself to winter conditions, says Dr. H. C. Young, chief of the department of botany and plant pathology of the Ohio Agricultural Experiment Station. Here is his explanation.

"During the growing season the leaves contain three pigments: green, or chlorophyll; red, or xanthophyll; and yellow, or corotin.

"The green pigment is formed only at summer temperatures and is responsible for the manufacture of all the foods used and stored by the plant. As cooler temperature prevails in the fall the green pigment is no longer formed and instead the red and yellow pigments develop in greater abundance.

"The red and yellow tend to raise the temperature and thus facilitate the transfer of food from leaves to the storage regions of the plant. This is Nature's way of preparing for winter in the shortest time.

"Temperature and moisture are factors that influence these changes. Color production is not dependent upon frost. In fact more beautiful colors are produced when temperatures do not quite reach the freezing point during this period.

"An early frost prevents the formation of the special layer of cells, called the abscission layer, at the base of the petiole of the leaf, which cut off the leaf and at the same time heals the wound. When factors are favorable for the early and quick development of the abscission layer, more sugars are held in the leaves and go to form even more brilliant colors."

FEED COST AND RETURNS FOR VEAL CALVES

JOHN F. DOWLER

The sale of veal calves on 23 Putnam County farms during the years 1926 to 1928, inclusive, gave a return of $11.86 per head over their feed cost as calculated from cost records. This return was the compensation the farmer received to cover the cost of calf when dropped, his labor in feeding the calf, and any other expense.

Records were kept on 122 calves during the three years. These veal calves were kept on an average of 50 days and consumed 130 gallons of whole milk and 10 gallons of skimmilk during that period. Most of the calves took the milk directly from the cow, while about 20 percent were bucket fed. One farmer fed a small quantity of meal in addition to whole milk. The feed cost ranged from $10.74 to $19.83 per head, and averaged $13.79. Milk was charged to the calf at 10 cents per gallon when taken direct from the cow and 12 cents per gallon when fed from a bucket.

Returns Above Feed Cost for Veal Calves

Grouped according to weight when sold

Group	Months on farm	Amount of feed and cost					Receipts		Returns above feed
		Whole milk		Skimmilk		Total cost			
		Amt.	Value	Amt.	Value		Weight	Value	
	Mo.	*Gal.*	*Dol.*	*Gal.*	*Dol.*	*Dol.*	*Lb.*	*Dol.*	*Dol.*
1....................	1.6	121	12.58	4.9	.15	12.77*	162	22.66	9.89
2....................	1.8	124	12.77	19.9	.60	13.37	188	26.48	13.11
3....................	1.7	143	14.88	5.4	.16	15.04	202	27.44	12.40
Average...........	1.7	130	13.48	9.7	.29	13.79	185	25.65	11.86

*Also includes a small quantity of calf meat.

The weights at which the veals were sold also varied. The lightest one weighed 130 pounds and the heaviest 250 pounds. The group averaged 185 pounds. The accompanying table shows that, arranged into three approximately equal groups according to the weight when sold, the medium weights gave the largest margin of return above feed cost. The time spent in feeding and caring for the veal calves averaged 10 minutes per day, or 8¼ hours per head for the period of time they were on the farm.

OCCUPATIONAL HISTORY OF 1063 OHIO FARM HOUSEHOLDS

P. G. BECK

Changes from other occupations to farming had been made by 27 percent of the 1063 farmers represented in a current study made by the Department of Rural Economics on the movement of farm population in Ohio. The remaining 73 percent had always farmed either as a part or full time occupation.

The history from which these figures were taken covers only the period since the formation of each particular household as a separate economic unit; some of the 73 percent previously may have worked at other occupations.

Occupational Status and History of 1063 Farm Households

Percentage of households by sections of State

	Total	West	Northeast	Southeast
	Pct.	*Pct.*	*Pct.*	*Pct.*
Total	100	100	100	100
Always farmed	73	84	57	82
Now farming, had been non-farmer	27	16	43	18
Farming only	84	90	73	92
Farming, with supplementary occupation	16	10	27	8

Sample areas for this study were taken from three sections of the State, under widely varying farming conditions. The "West" in the table consists of samples taken from some of the best farming regions of western Ohio; the "Northeast", from the highly urbanized industrial section of northeastern Ohio; and the "Southeast", from the hill-farming region of southeastern Ohio. Distributions for the first and third are quite similar. The Northeast section reveals an entirely different situation than that found in the other two sections. Only 57 percent of the farm households had always farmed, and 27 percent had supplementary occupations.

The high percentage of households in the northeastern Ohio area that had previously worked in other occupations is largely accounted for by the influx of foreign born households during the last 10 or 15 years. Of the foreign born, 88 percent, as compared to 30 percent of native born, had worked at other occupations.

The greatest amount of shifting from other occupations to farming is taking place around our industrial centers.

CROP PRODUCTION AND TOTAL VALUE

J. I. FALCONER

At this time when there is so much discussion about agricultural surpluses and their effect upon price, it is of interest to see what the effect of volume of production of four of our staple Ohio farm crops has been upon total value during the last seven years. The data given in the table below relate to the total crop of United States for each year since 1922. The average production for the last seven years was taken as normal and the production for each year computed as a percent of this normal. The value of the crop given is the total production for the year multiplied by the average price per bushel during the period of disposal of the crop.

Percentage of Normal Crop and Total Value in Millions of Dollars

Year	Corn		Oats		Wheat		Potatoes	
	Percent of normal crop	Total value in millions of dollars	Percent of normal crop	Total value in millions of dollars	Percent of normal crop	Total value in millions of dollars	Percent of normal crop	Total value in millions of dollars
1922	83	2,491	88	591	81	984	80	659
1923	97	1,787	91	486	96	730	88	476
1924	99	2,304	93	513	100	1,023	99	410
1925	102	2,354	97	556	104	1,067	103	374
1926	104	2,130	108	615	104	837	104	296
1927	105	2,010	111	578	106	1,038	112	310
1928	110	2,333	112	736	109	906	114	271

The data would indicate that with corn during the last seven years, the total value of the crop has been little influenced by the total production. With wheat the three years of highest total value have been years of nearly normal crops. With oats, while there have been exceptions, the tendency has been for the large crops to have the greatest total value. With potatoes, however, there is a marked tendency for the small crops to bring the greatest total return. It is of course true that total production is the product of acres times yield per acre. The difference in per bushel cost of growing large and small yields would also have to be taken into account before a full comparison as to profitableness could be made.

INDEX NUMBERS OF PRODUCTION, PRICES AND INCOME

J. I. FALCONER

As in the earlier months of the year, the July and August income from cash sales showed an improvement over the corresponding months of last year. Up to the end of June the income from the sale of grain was 20 percent below last year. By August, however, the sales for the year were over 20 percent above those of the same period in 1928. This improvement came mostly in the larger wheat crop of this year. As compared with last year potatoes show the most favorable price comparison and wool the poorest. It is of interest to note the comparative stability of the general price level for the last ten years.

Trend of Prices and Wages, 1910-1914=100

	Wholesale prices all commodities U. S.	Weekly earnings N. Y. state factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm products prices	Ohio cash income from sales
1913	102	.....	100	100	104	100	105	104
1914	100	100	101	102	102	102	105	109
1915	103	101	106	100	103	107	106	109
1916	130	114	123	117	113	113	121	119
1917	181	129	150	176	140	119	182	191
1918	198	160	178	200	175	131	203	242
1919	210	185	205	209	204	135	218	268
1920	230	122	206	205	236	159	212	225
1921	150	203	156	116	164	134	132	129
1922	152	197	152	125	145	124	127	127
1923	156	214	153	135	166	122	134	137
1924	152	218	154	134	165	118	133	139
1925	161	223	159	146	165	110	159	147
1926	154	229	156	136	170	105	155	156
1927	149	231	154	131	173	99	147	144
1928	153	232	156	139	169	96	153	134
1928								
January	151	230	.....	137	158	.....	141	139
February	151	230	.....	135	.....	.....	141	127
March	150	233	155	137	.....	.....	145	126
April	152	227	.....	140	172	96	152	127
May	154	230	.....	148	.....	.....	167	135
June	153	232	157	145	.....	.....	163	142
July	154	230	.....	145	173	.....	162	132
August	155	231	.....	139	.....	.....	158	119
September	157	234	155	141	.....	.....	158	121
October	153	234	.....	137	174	.....	153	139
November	151	233	.....	134	.....	.....	146	151
December	151	237	.....	134	.....	.....	147	151
1929								
January	152	234	156	133	166	.....	144	141
February	151	236	156	136	.....	.....	149	133
March	153	239	159	140	.....	94	155	134
April	132	237	156	138	163	.....	150	138
May	150	236	156	136	.....	.....	152	140
June	151	236	156	135	.....	.....	153	147
July	154	235	156	140	172	.....	157	163
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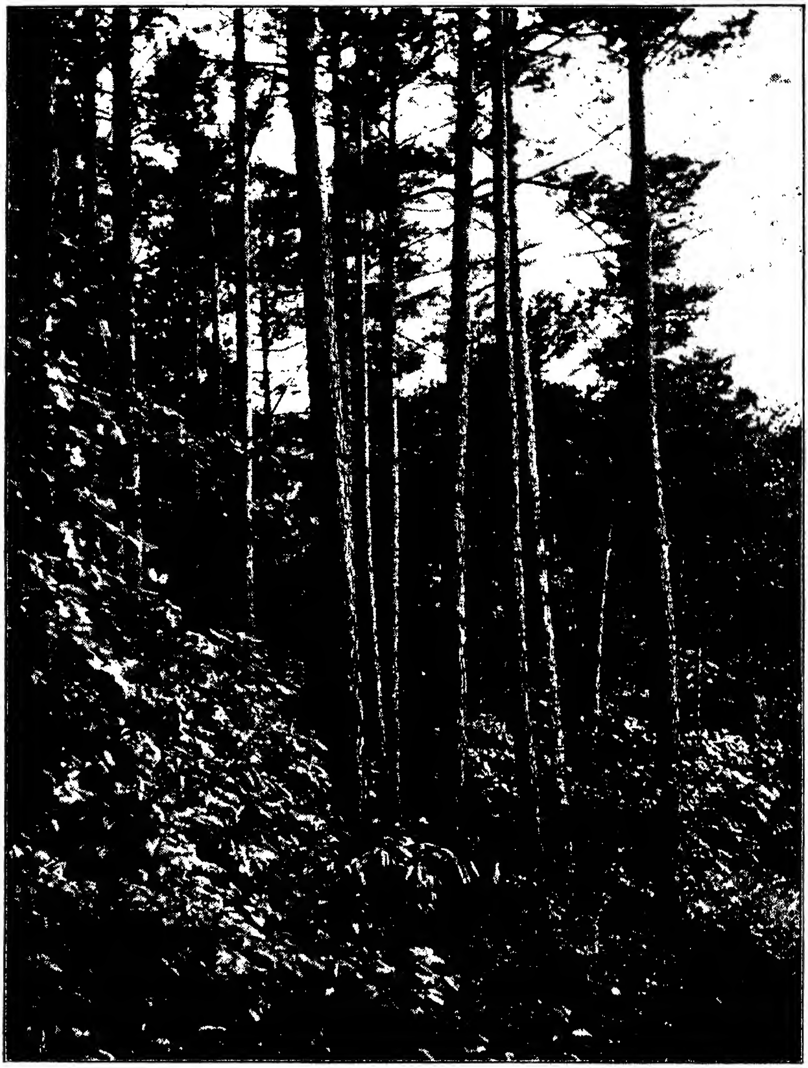


Second-growth pine in the Shawnee State Forest

The hope of the future rests with the second-growth forest. Stands of this character will also increase timber yields many many times the current average.

HEALTHY BLACK RASPBERRY PLANTS

H. C. YOUNG AND J. S. SHOEMAKER

That black raspberry plants can be maintained in healthy condition has been shown by experiments extensively conducted thruout the State. On the other hand, that diseased plants shorten the life of a raspberry plantation and greatly reduce yield and profits has been common experience.

Some years ago the disease situation in raspberries became so serious that many growers gave up culture of this fruit. Acreage of raspberries in the State decreased nearly one-half. In one county the acreage rapidly dwindled from 600 to less than 100 acres. The trouble was not over-production. Demand for the fruit and prices were good. The chief factor was disease.

The raspberry industry in Ohio seemed doomed. Little progress was made until it was found that virus diseases (leaf curls, mosaics, and streaks) were involved. Familiarity with these diseases in itself did not solve the problem. Spraying was ineffective. Healthy stock for planting was recognized as necessary. It was easy enough to advise a grower to secure healthy plants but it was difficult to tell him where he could get them.

About five years ago the Ohio Experiment Station distributed as healthy plants as could be found of Cumberland and Plum Farmer black raspberry to a number of growers thruout the State. The Station has rogued these plants very strictly for virus diseases. The purpose was to make available to Ohio growers a supply of plants exceptionally free from virus diseases. This, in brief, was the beginning and purpose of the Ohio Small Fruit Improvement Association.

Last summer a two-day raspberry tour was conducted in northern Ohio thru healthy raspberry fields and thru other fields for comparison. There was a large attendance and the results of the roguing, conducted by L. M. Cooley of the Plant Pathology Department here, were impressive.

The Ohio Experiment Station advises the setting of healthy plants.

The plantation illustrated in Figure 1 is an example of "practicing what you preach." This is a plantation at the Ohio Experiment Station, contains 830 registered grade Cumberland black raspberry plants purchased from the Ohio Small Fruit Improve-

ment Association, and set early in the spring of 1928. No attempt was made to select the best field in the Association as the source of plants. The plants simply were obtained from the grower nearest to Wooster, whose plants met Association standards. We sent a truck for them one afternoon and set them the next day. More than 90-percent stand was obtained; replanting gave practically a perfect stand.

Fig. 1.—Two-year-old plantation of Cumberland black raspberries set with plants purchased from the Ohio Small Fruit Improvement Association

Four thoro inspections for disease were made the first year by C. W. Bennett and L. M. Cooley; hundreds of visitors, including experienced raspberry growers, walked thru this plantation. No virus diseases were found at the first three inspections, made at monthly intervals. This indicated the exceptional freedom from disease of the plants set. At the fourth inspection one diseased plant, due to leaf curl, was removed. In 1929, the second year, the plantation was again thoroly inspected four times for disease; two diseased plants were removed, one of mosaic and one streak plant.

The facts that the first three inspections failed to disclose any virus disease and that some crept in later is interesting. It brings up the matter of isolating healthy plants. Investigation indicated that the disease had been transmitted to the healthy plants from diseased raspberry plants more than 20 rods away. This distance

is mentioned because it has been suggested as suitable separation of healthy plants from diseased plants. That 20 rods is not far enough to afford absolute protection against disease transmission is evident. For most practical purposes, however, it is sufficient. Removal of only 1 plant the first year and 2 plants the second year from a plantation of 830 plants is indicative of results that may be obtained with healthy plants. More such healthy plantations would be a boon to the raspberry industry of Ohio.

What happens when healthy plants are set near disease sources? An example may again be taken from plants at the Station. For many years it has been the custom to maintain a variety collection of raspberries. Purple, red, and black raspberries and blackberries have been planted in proximity. The result was that the blacks produced a few crops and then were practically worthless. An explanation for this is that purples and reds are usually infected, even so-called guaranteed "mosaic-free" plants, with virus disease that is not greatly harmful to them; but after plant lice feed on the reds they may transmit the disease to black raspberries and cause severe infection.

There are many instances where healthy Cumberland or Plum Farmer black raspberry plants set near red or purple raspberries or wild brambles have shown a very high percentage of virus disease the first year. A grower may believe that these black raspberry plants were diseased when obtained when such may not be true at all. Black raspberry plants set near Latham or King red raspberries in particular soon become badly infected. Occasionally black raspberries, free of disease, are found near some reds or blackberries, but the best plan is to separate them by at least 20 rods, the farther away the better. The direction and velocity of winds and obstacles between the patches is also important in checking disease transmission. Planting black raspberries near disease sources is poor practice and has been a serious drawback to the black raspberry industry.

Setting plants that are free from virus disease in a well isolated site is not a guarantee of success, altho success is seldom obtained without this precaution, altho other factors also require attention.

Heavy infection of anthracnose is not conducive to success. Anthracnose may be checked in at least two practical ways. One is to cut off the "handles" of tip layered plants immediately after they are set early in the spring, leaving no wood above ground. Unless this is done early the new shoots as they appear thru the

ground are infected from the anthracnose spores on the old wood. If the "handles" are removed chance of anthracnose infection is greatly minimized. Anthracnose spreads only from one plant to a neighboring one thru splashing about of spores by rain, etc., and thus is localized in the plantation. It is not normally transferred from one section of the plantation to another section as are the virus diseases. Another remedy for anthracnose is spraying canes with lime-sulfur solution.

Care in handling the plants is necessary from the time they are dug until planted. They should be dug and planted as near the dormant condition as soil and weather permit. Poor results are often due to late digging, shipping and planting, as a consequence of delayed ordering.

Young raspberry plants are perishable. Do not unnecessarily expose them to wind or sun, as they dry out quickly and die or are weakened. After the plants are dug, cover quickly and take without delay to a cool place. Heeling-in is only a fairly efficient method of keeping raspberry plants in good condition; many failures have resulted from plants heeled-in at the nursery or by the grower. In packing, surround plants with sphagnum moss, or other material, that has been well soaked and squeezed free of surplus water. The proper amount of moisture to leave in the packing depends on such factors as distance the plants are to be shipped, type of container, temperature, and stage of growth. Too much moisture in the packing material in large containers may result in heating, molds, or other adverse condition. Usually the material is too dry rather than too wet in bushel baskets or smaller packages. Pack and ship only plants with good thrifty root systems; small plants give a poor stand and may cause the loss of practically a year's time.

If the plants are not received in good condition the grower has cause for complaint and should seek satisfaction from the proper source. If plants are accepted and then allowed to weaken or die thru carelessness or delay in handling or planting, responsibility rests with the grower. Plants weakened by drying out, heating, checked growth, or other cause, are likely to be stunted and unsatisfactory.

It is advisable to obtain plants from a healthy plantation near where they are to be grown. This reduces the time between digging and planting and keeps down transportation charges. Every day that raspberry plants are out of the ground may lower

their vitality. Many successful growers wisely insist on going to a nursery field to obtain plants and on setting the plants directly in their fields the same day, if possible.

To prevent drying out and weakening of plants at planting time take the plants to the field wrapped or covered with wet burlap or other moist material, or dip the roots in muddy water. Do not drop more than a few plants ahead of the planters; this is especially important under dry weather conditions. Avoid delay in handling and setting plants. Plants cannot be expected to thrive well after being allowed to lie around for some time. Fall plowing aids early drying of the soil in the spring and desired early spring planting.

Have the soil well prepared and in good state of fertility, particularly with respect to humus, for the plants.

Set the plants firmly, without injuring the tender sprouts, at about the same depth they had been growing. If set too shallow or if the soil is not adequately firmed many of the plants dry out. Such factors as poor root development, heaving out, weak plants, injury from drouth, and blowing over of the canes may also be encountered with shallow planting. If set too deep the growing points may not push thru the soil, a common cause of a poor stand, especially on heavy soils. After placing tip plants in the holes it is often advisable to pack soil around the roots and sprouts by hand before filling in with more soil; thus enabling the soil to be firmed with a minimum of damage to the tender growth. This takes time but it is usually energy well spent.

The precautions outlined are of little avail if plants are set in poorly drained soil. Good drainage is essential in a raspberry field. Much damage that growers confuse with disease is due to poor drainage. Tiling and open furrows are often necessary. As a rule, the higher parts of a field are better than low-lying or bottom sections. In fields where drainage is the limiting factor, fertilizers or good cultural practices will not give desired results until drainage is improved.

It is not the purpose of this article to outline in detail the various cultural practices or the nature and control of various diseases and insects. These will be considered later in a Monograph Bulletin. This article serves its purpose if it encourages the use of healthy plants, adequate isolation from disease sources, care of handling from digging to planting, good drainage, and general care needed to establish a plantation with prospects of being successful.

ADDITIONAL SUGGESTIONS ON SPRAYING WEEDS WITH CHLORATES

C. J. WILLARD

Suggestions on the use of chlorates for weed killing were made in the Bimonthly Bulletin for July-August 1929. Tests of these materials were made during 1929. Some 200 different plots at Columbus, 150 at the Mahoning County Experiment Farm, and smaller numbers at the Miami County Experiment Farm, the Northeastern Test Farm, and the Southeastern Test Farm were sprayed. The results of many of these applications will not be known until next year, but some tentative observations seem important enough to pass on at once to those who wish to experiment with this method of weed killing.

Already a few serious accidents from sodium chlorate have been reported in Ohio and neighboring states. *Do not use this material without observing all the precautions given in the article in the July-August Bimonthly Bulletin.*

We also wish to emphasize again that this method is recommended for small areas only. Unless more efficient methods of using it are worked out, it is not likely to be profitable on large areas.

The most outstanding result of the year's work is the value of spraying in the early spring. Sprays applied in April or early May, before much growth had taken place, were much more effective than at any later date up to September 1. Probably at any time after the ground thaws would be satisfactory. For Canada thistles, spraying at full bloom is probably the most favorable stage during the summer, seemingly because the thistles are weakest at that time, but early spring sprays proved very much more effective per pound of chlorate used. While the 1929 results are not yet available, there is reason to believe from a few tests in 1928 and from work at other Stations that late fall spraying will also prove effective.

Spraying when the soil was wet proved definitely favorable to killing. The difference was sufficient to raise a question as to the advisability of spraying any perennial weeds when the ground is dry.

It seemed to take nearly as much spray to kill sprouts that recovered after spraying as to kill unsprayed plants. If this be

true, an initial application that does not kill most of the plants is largely wasted. While it may be possible to reduce the recommendation later, we would not now recommend an initial application of less than two pounds per square rod for either quack grass or Canada thistles. More may be better. Canada thistle roots were harder to kill than quack grass.

Fig. 1.—A.—An area (in front of corn) of Canada thistles sprayed April 24. Only a few thistle sprouts visible. Corn was planted on the area but did not germinate.
B.—Left, two representative hills of corn on land not sprayed in 1928. Right, two hills from land sprayed June 15, 1928. Many stalks on sprayed land bore no ear shoots and showed a peculiar dying of the center of the leaves. Miami County Experiment Farm, August 17, 1929.

On areas sprayed in 1928 and planted to corn in 1929, the corn was quite seriously injured, reducing the yield. Oats under similar conditions were slightly injured, but seemed to outgrow it. Wheat sown in the fall of 1928 on areas sprayed in 1928 was killed, but clover sown in that wheat in the spring of 1929 made a stand,

except where a very heavy application had been made. Apparently in Ohio we will have to count on more injury from chlorates to succeeding crops than western reports had led us to believe.

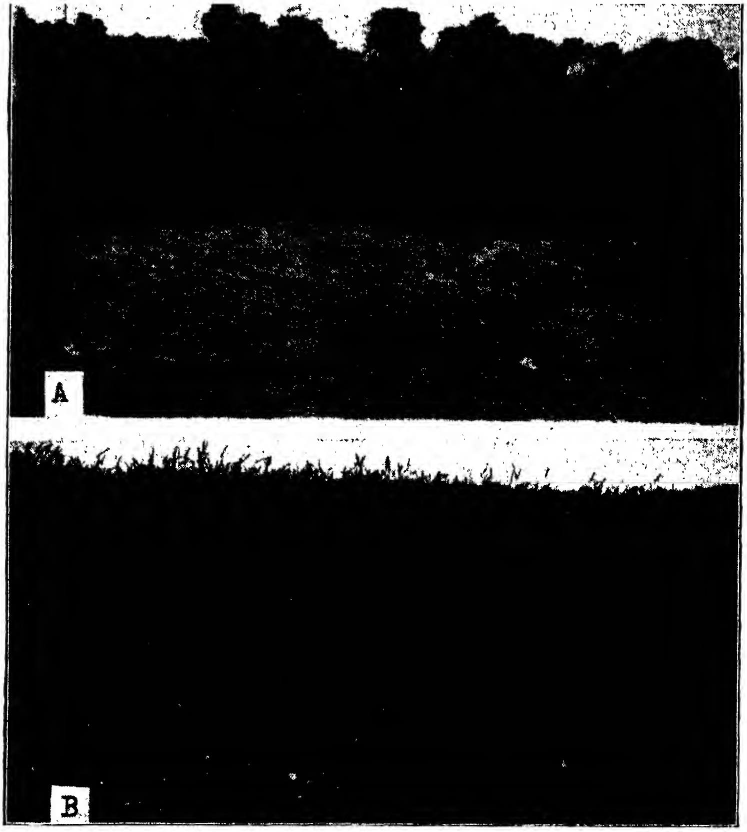


Fig. 2.—A.—Area in front where quack grass had been heavily sprayed May 24, two weeks before oats were planted. Every trace of quack was eliminated by this one spray.
B.—Foreground, area where quack had been killed by two sprays in the summer of 1928. Wheat sown in the fall of 1928 was killed on the sprayed spots, but clover sown in the spring of 1929 was growing well. Northeastern Experiment Farm, July 10, 1929.

At two farms, oxeye daisy was killed by spraying in July with one gallon to the square rod of solution containing 8 ounces of sodium chlorate to the gallon. Applied at this season, spray of this strength killed the daisies and did not kill the grass in which they were growing. White snakeroot was killed by one application of spray containing one pound to the gallon.

There seems to be at least a partial correlation between the ease of killing perennial weeds and the depth of their root systems. In most instances those with shallow root systems were readily killed, while those with deeper root systems were more resistant.

Calcium chlorate has been tested in the only form in which it is commercially available, a commercial weed killer. This product contains 56 percent calcium chlorate. Without making detailed comparisons, this product is at least as effective as sodium chlorate in proportion to its chlorate content, but is not equal to sodium chlorate pound for pound. The greatly diminished fire hazard with calcium chlorate is an important point in its favor.

ALTERNARIA BLIGHT OF GINSENG, PRELIMINARY EXPERIMENTS IN THE CONTROL

J. D. WILSON AND H. A. RUNNELS

Alternaria blight has been a serious disease in ginseng plantings in the United States for at least 25 years. It has become prevalent in Ohio during the last few years, especially in woodlot plantings. Altho literature on the control of Alternaria blight has been available since 1912,* growers have not made full use of the information, as evidenced by the losses which they still suffer.

The cause of this disease is the fungus *Alternaria panax* Whetzel. This fungus disease usually makes its first appearance in the early summer as elongated, brown areas on the lower part of the stems. A velvety mass of spores is soon produced over the surface of these areas. These spores serve to spread the disease to leaves and other parts of the plants during subsequent periods of rain and high humidity. Infected areas on the leaves first appear as water-soaked spots of varying size up to one-half inch in diameter. These may coalesce to cover most of a leaf. The central part of the affected tissue soon dries out, becoming light-colored and papery in texture, (Fig. 1). The marginal portion grades off into a yellowish or reddish brown. The petioles, in cases of severe infection, may be so weakened that they droop or fall from the stem. In some cases the seed heads are infected and the berries later shell.

*Whetzel, H. H. and J. Rosenbaum. The diseases of ginseng and their control. U. S. Dept. Agr., Bur. Pl. Indus. Bul. 250:1-44, 1912.
Whetzel, H. H., J. Rosenbaum, J. W. Brown, and J. A. McClintock. Ginseng diseases and their control. U. S. Dept. Agr. Farmers' Bul. 736:1-22, 1916.

The fungus lives over winter as mycelium in the stems and leaves which were diseased the previous season. About the time the ginseng starts growth in the spring the fungus in the refuse about the beds becomes active and produces a crop of spores. These are spread by wind and rain and infection of the young plants soon follows. Thus, control measures for this disease should include the destruction of the old leaves and stems. Another precaution is that of soaking the soil of the beds in the fall after the

Fig. 1.—Young ginseng plant infected with *Alternaria panax*

plants have died down with a solution of 1 pound of copper sulfate to 7 gallons of water. The first inch of soil should be wetted with the solution. These precautionary measures should be supplemented by a spray schedule during the growing season, similar to the one used in the experiments described below. The sprays should be applied at intervals short enough to keep all new growth covered.

During the last three summers the authors have carried on some experiments on the control of this disease. A number of ginseng beds now under experiment are to be treated thruout the period of development of the plant, about five years. A given bed is to receive the same treatment each year. The results reported in this paper are preliminary, part of them being relevant to these five-year tests.

During the summer of 1928 the dusts and sprays listed below were tried on a series of plots in a woodlot planting at Wilmot, Ohio. The dusts were (1) a 20-80 copper lime, applied to dry plants in one case and in the other to plants just previously wetted with water; (2) a 20-30-50 copper-kaolin-lime; and (3) a 35-65 copper-lime. Monohydrated copper sulfate and a good grade of freshly hydrated lime were used. The sprays included a 3-4-50 bordeaux mixture without soap, the same bordeaux with resin fish-oil soap added at the rate of 1 pound to 50 gallons of spray material, ammoniacal copper carbonate (3 ounces $CuCO_3$ + 3 pints of ammonia in 50 gallons of water), colloidal copper sulfide 4 pounds in 50 gallons of water, and Kurtakol (4 pounds in 50 gallons of water).

TABLE 1.—Alternaria Blight Control Treatments and Results at Wilmot, Ohio, 1500 Plants in Each Treatment

Treatment	Plants diseased	Percentage of total diseased
	No.	*Pct.*
Check	1296	86.4
20–80 copper-lime dust	1260	84.0
Colloidal copper sulfide 4 lb. to 50 gal. water	956	63.7
Bordeaux mixture, 3–3–50	34	2.3
Bordeaux mixture + 1 lb. aluminum hydrate	34	2.3
Bordeaux mixture + 1 lb. fish oil soap	31	2.1
Bordeaux mixture + 1 lb. soap + 1 lb. arsenate of lead	26	1.7
Bordeaux mixture + 1 lb. soap + 1 lb. manganar	24	1.6

All of the plots except the two treated with the bordeaux sprays showed at least 50 percent infection at the end of the season. Less than 5 percent of the plants in the bordeaux plots were infected. Similar results were obtained in the summer of 1927. That is, dusts were found to be of little value in controlling this disease, but bordeaux mixture was quite efficient.

In the spring of 1929 a series of eight plots were selected in woodlots at Wilmot and Orrville, Ohio. The treatments used were those listed in the table. The spray schedule included applications

as follows: (1) at the time when a majority of the plants had broken thru the soil, (2) when the leaflets were fully spread, (3) just before bloom, and (4) just after the fruits were well set. Due to a misunderstanding on the part of the owner only the last three applications were made on the plots at Orrville. The omission of the first application may have been responsible for the fact that most of the plants in these plots were killed by Alternaria blight before the end of the growing season. The occompanying table gives the results obtained in the Wilmot series.

These results again indicate that a copper-lime dust is not effective in control. This may possibly be due to the fact that the leaves of the ginseng plants are not wetted with dew as leaves are in the open, hence the copper and lime are not combined to form a bordeaux with the result that its usual toxic action is greatly reduced. Also, the material is easily washed off by rain. There is little indication that the addition of any of the materials listed in the table to bordeaux mixture significantly affected its efficiency. This is to be expected since the bordeaux mixture alone gave very excellent control. The addition of soap, even in small quantities, made it much easier to obtain a good covering of the plants with spray material and thus greatly facilitated the work of spraying.

FORAGE CROPS FOR GROWING AND FATTENING PIGS

W. L. ROBISON

In order to bring out more clearly any differences in value that might exist in the forage crops that were being compared, a limited amount of grain or concentrates was fed during the early part of this experiment,after the first six weeks this was increased to a full feed.

Soybean pasture is especially palatable to pigs; but it does not grow again after being grazed and is killed by frosts, hence its carrying capacity is not as great as that of some other crops and the period during which it provides forage is relatively short. In order to provide the pigs with soybean forage for as long a time as possible they were transferred to a second seeding on September 11, when very little forage was left on the first plot. While on

plots of equal size in an experiment conducted in 1924, pigs on soybean pasture gained only 87 percent as rapidly as those on rape and required 15 percent more feed per unit of gain.

Sudan grass, one of the sorghums, produces new growth after being clipped or grazed, but like soybeans is killed by frost, and so is a relatively short-season crop. Perhaps better results would have been secured from the Sudan grass if it had been clipped in mid-season. Possibly a heavier seeding than 20 pounds to the acre would also have been preferable. Indications are that it is fairly palatable but hardly as valuable for pigs as some of the other annual forages.

TABLE 1.—Forage Crops for Growing and Fattening Pigs

Started July 17, 1929	Soybean pasture	Sudan grass	Peruvian alfalfa	White sweet clover	Alfalfa	Dwarf Essex rape
	Shelled corn and tankage					
Acres of forage	0.75*	0.5	0.5	0.5	0.5	0.5
Number of pigs	8	8	8	8	8	8
Initial weight per pig	61.6	62.9	61.7	61.6	61.4	62.1
Final weight per pig	209.8	191.6	199.9	194.4	207.7	209.7
Average daily gain	**1.32**	**1.15**	**1.23**	**1.19**	**1.31**	**1.32**
Daily feed per pig:						
Corn	4.64	4.40	4.49	4.57	4.47	4.61
Tankage	.32	.32	.32	.32	.32	.32
Salt	.01+	.02	.02	.02	.01+	.02
Total	**4.97**	**4.74**	**4.83**	**4.91**	**4.80**	**4.95**
Feed per 100 lb. gain:						
Corn	350.41	382.83	364.42	385.39	342.04	349.94
Tankage	24.25	27.94	25.87	26.99	24.57	24.36
Salt	1.18	1.75	1.49	1.70	1.07	1.52
Total	**375.84**	**412.51**	**391.56**	**414.08**	**367.68**	**375.82**
Cost of feed per 100 lb. gain	$7.11	$7.83	$7.42	$7.84	$6.98	$7.11
Cost of feed and pasture per 100 lb. gain†	$8.13	$8.53	$8.13	$8.53	$7.66	$7.75

*By October 16 the soybean forage remaining was killed by frost. One-half acre additional was used but one-fourth would probably have furnished an abundance of forage until killing frost, hence the pigs were charged with a total of three-fourths acre.

†A charge of $13 an acre was made for rent on the land and preparing the seedbed. With the exception of allowing $1.50 an acre for cultivating the rape, this plus the cost of the seed made up the pasture charge. The alfalfa was figured at a cost of $16 an acre.

Soybeans, 2 bushels per acre at $1.50 a bushel; Sudan grass, 20 lb. at 7¢ a lb.; Peruvian alfalfa, 12 lb. at 21¢ a lb.; white sweet clover, 15 lb. at 11¢ a lb.; dwarf Essex rape, 5 lb. at 9¢ a lb.

Shelled corn $0.98 a bu.; tankage $80 a ton; salt $20 a ton.

Sweet clover, in our experience, has not been palatable to pigs. Since the second year's growth is coarse and woody, the practice of seeding sweet clover in the spring and pasturing it the same season has been followed. This year, due to wet weather, the seeding was late and the crop failed to produce as much growth and was weedier

than usual. Without exception, however, pigs on sweet clover pasture have grown more slowly and required more feed per pound of gain than similar pigs on rape pasture.

Peruvian alfalfa is a rapidly growing variety which does not ordinarily live thru the winter where the temperature falls below 10 above zero. It was grown to determine whether a rapid growing strain of alfalfa would not give better results than sweet clover when both were seeded in the spring without a nurse crop and pastured during the summer and fall of the same season. Despite the handicap of a late seeding the results indicate that Peruvian alfalfa is worthy of consideration for use as an annual forage crop for pigs.

Fig. 1.—Pigs on rape pasture

Dwarf Essex rape is one of the outstanding forages that can be pastured the same season it is seeded. It can be seeded early, produces new growth after being grazed and provides forage until late in the fall. On productive soils it usually makes an abundant growth. By seeding it in rows 24 inches apart, which can be done with a drill having a part of the holes stopped with corks, the rape can be cultivated a time or two to stimulate growth and to keep the weeds down while the plants are small.

Whenever alfalfa or red clover is available it will take the place of annual forage crops. Red clover was not tried in this test but other trials have shown little difference in the worth of the two crops. Few if any forages surpass them in value as pasture crops for pigs. By planning ahead it should not be difficult to provide

the pigs with some clover or alfalfa. Fencing off a portion of the clover or alfalfa field with a temporary fence and using it as pasture for the pigs would not only result in good returns for the crop but would also fit in with the system of swine sanitation recommended for keeping down diseases and parasites. The other forages, of course, have a place as supplementary or emergency crops or for growing in lots about the buildings.

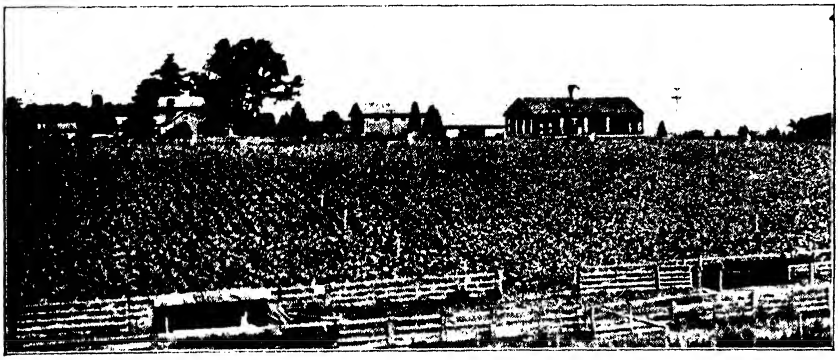


Fig. 2.—Rape forage; seeded in rows 24 inches apart

MIDDLINGS, "PALMO MIDDS," AND COCOANUT MEAL FOR PIGS

W. L. ROBISON

What middlings are worth depends upon how they are used. For feeding with corn and tankage to fattening pigs, flour middlings had a value 7 percent greater than an equal weight of corn. When fed in the place of linseed meal with corn, tankage, alfalfa, salt, and limestone, Table 1, they were worth 87.4 percent as much as corn. An excellent grade of standard middlings was worth 7 percent less than the flour middlings. The price of middlings is often higher than their feeding value would justify. Those who use them have the ability to control the price by feeding something else and refusing to buy when they become too high. Middlings are probably worth more for sows in lactation and for suckling and weanling pigs than for older pigs, but it is questionable whether their value even for these is much more than 10 percent greater than that of an equal weight of corn.

Palmo midds when constituting 18 percent of the ration, showed a higher value than middlings similar to those used in their manufacture. In an earlier test, in which they made up 25 percent of the ration, they proved somewhat distasteful at first and made a less favorable showing.

TABLE 1.—Middlings, "Palmo Midds," and Cocoanut Meal for Pigs

Experiment started Dec. 6, 1927. Six pigs per lot; hand-fed

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
Primary or basal feeds	Corn, tankage, ground alfalfa, minerals*					
Secondary feed†	Linseed meal	Flour middlings	Standard midds.‡	"Palmo midds"	Cocoanut meal	Cocoa bean meal
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Initial weight per pig	65.1	65.4	65.1	65.1	64.8	65.0
Final weight per pig	200.4	211.9	207.7	203.1	205 1	108.6
Average daily gain	**1.07**	**.99**	**1.07**	**1.10**	**1.11**	**.28**
Daily feed per pig:						
Corn	3.68	3.16	3.31	3.28	3.44	1.65
Secondary feed	.14	.62	.81	.82	.67	.33
Tankage	.29	.21	.27	.27	.21	.12
Ground alfalfa	.09	.09	.09	.09	.09	.04
Minerals	.06	.06	.07	.07	.07	.04
Total	**4.26**	**4.14**	**4.54**	**4.52**	4.48	**2.18**
Feed per 100 lb. gain:						
Corn	342.66	319.60	309.04	299.09	309.06	597.05
Secondary feed	13.31	62.74	76.14	74.26	60.42	118.31
Tankage	26.62	21.30	23.02	24.77	19.20	45.74
Ground alfalfa	7.93	8.37	8.46	8.25	8.05	15.77
Minerals	5.95	6.27	6.35	6.19	6.04	11.83
Total	**396.47**	**418.28**	**423.01**	**412.56**	**402.77**	**788.70**
Cost of feed per 100 lb. gain	$7.52	$7.89	$7.91	$7.62	$7.57	$14.88

*Minerals=Salt, 1; limestone, 2.

†Fifteen pounds of flour middlings, of cocoanut meal, or of cocoa bean meal, or 18 pounds of standard middlings or of "Palmo Midds" was included in each 100 pounds of total feed.

‡Those middlings were of good quality and should perhaps be classified as choice fine middlings, the grade between standard and flour middlings, rather than as standard middlings.

Corn 91¢ a bu.; grinding 10¢ a 100 lb.; linseed meal $52, flour middlings $42, standard middlings $38, "Palmo Midds" $34, cocoanut meal $42, cocoa bean meal $40, tankage $80, ground alfalfa $40, salt $20, and limestone $10 a ton.

The pigs getting the ration containing cocoanut meal made slightly faster gains than those getting the one containing linseed meal. They required a trifle more feed, however, for each pound of gain produced. At the prices used, the other feeds replaced by the cocoanut meal would give it a value of $40 a ton.

Cocoa bean meal is the ground product resulting after the oil or "cocoa butter" has been pressed from cocoa beans for the manufacture of chocolate and breakfast cocoa. Poor results were also obtained from its use in Denmark and by Alpin, as reported in Vermont Bulletin No. 271, and were attributed to the presence of the alkaloids, theobromine and caffeine.

SOWING SWEET CLOVER IN WHEAT

C. J. WILLARD AND L. E. THATCHER

There has been difficulty on several soil types in the State in obtaining a stand of sweet clover in wheat, even tho good stands are obtained in early oats on the same soil. Sowing scarified sweet clover on honeycombed ground, as red clover is sown, is not always satisfactory. Scarified sweet clover seed germinates more quickly than red clover seed—two or three days of mild weather oftentimes being sufficient to cause many seeds to sprout. A drop in temperature below freezing following this kills many of the sprouted seeds. When seeding is delayed until a drill can be used, the seed frequently is not covered, the surface soil may become too dry for the seed to sprout, and if it does start, the wheat has made such a growth as to offer serious competition.

Farm experiences and experiments at other Stations suggested sowing unscarified seed quite early as a means of meeting these difficulties. Trials of this method were made at Wooster (3 years) and Columbus (2 years). Sweet clover seed in the hull was sown at wheat seeding time and in December at Wooster, and in January and February at Columbus. Satisfactory stands of sweet clover were obtained from all of these dates of sowing. While it is not yet certain that the early sowing of seed in the hull, or even unscarified seed, on wheat will be superior to scarified seed sown in wheat somewhat later, the results tend decidedly in that direction. It is suggested that farmers who have had difficulty in obtaining stands of sweet clover in wheat try sowing seed in the hull, or unscarified seed, early enough to insure that it will be subject to a considerable amount of freezing and thawing.

Most sweet clover seed as harvested is covered with a waterproof layer, which prevents germination until it is broken. Freezing and thawing will do this, but when seed in the hull was sown after freezing weather had past, or was placed in a standard germination test, only 5 to 30 percent of it grew. "Scarified" seed is seed that has been treated to break this waterproof layer. It germinated 80 to 95 percent under the same conditions. Commercial seed that has been dehulled but not scarified will usually germinate 50 to 70 percent, since the hulling process scarifies much of the

seed. For fall and winter sowing, such seed is likely to be intermediate in value between seed in the hull and scarified seed. After the ground has thawed, only scarified seed should be sown.

Good inoculation was obtained at Wooster by treating seed in the hull with sweet clover cultures for fall and winter seeding.

In these tests 20 pounds to the acre of seed in the hull was used. Such seed can be obtained commercially but it will cost more for a seeding than the standard commercial scarified seed.

APPLE TREES PROPERLY FERTILIZED THRIVE IN SOD

L. WALTER SHERMAN

On the Mahoning County Experiment Farm a young orchard set out in 1921 partly in sod and partly under cultivation came into bearing in 1929 with fully half of the trees producing some fruit. While it may not be indicative of future fruitfulness of these two sections of the orchard it is interesting to note that the trees set in sod with proper yearly fertilization grew faster and came into bearing earlier than those grown under cultivation but without any nitrogen fertilizers applied.

The one section of this orchard was set out in the original native sod amid stumps and briars and has never been plowed or cultivated in any way. Since 1924 regular applications of nitrate of soda have been given this sod section, the amount being increased one-fourth pound each year till in 1929 the application was two and three-fourths pounds per tree. This is applied under the outer branches of the trees and is put on in the spring as soon as growth starts but before blooming. The sod section is mowed twice a year, the grass cut is allowed to remain where it fell or it is raked up and used as a mulch under the trees.

In the cultivated section of this orchard intercropping has been followed in part and in part summer tillage followed by a winter cover crop, such as rye and vetch. No intercropping has been done the last two years because of the conflict between the trees and the intercrop. No nitrates have been used about these trees but when an intercrop was grown it was liberally fertilized with commercial fertilizer.

We thus have in this orchard one section grown in sod, fertilized with nitrate of soda, and the weeds and grass kept under control by the use of mowing machine and scythe. Compared with

this is the other section grown without the use of nitrates, except when on intercrop, tillage being used to keep down weeds and promote growth, and a winter cover crop used to prevent erosion and leaching and to furnish humus.

In 1928 one variety fruited on the unfertilized cultivated section and four varieties on the fertilized sod. In 1929 the numbers were respectively nine and ten, a difference not as marked as that shown by the yields per tree under the two systems.

Leaving the variety question out the following table shows a very interesting contrast between these sections.

	Number of trees producing	Percent producing	Yield 1929	Average yield per tree
Cultural section of 39 trees	14	36%	81 Lb.	5.7 Lb.
Sod section of 64 trees	45	70%	409 Lb.	9.1 Lb.

We thus have nearly twice as large a percentage of the trees in the sod section producing fruit, with an average of 3.4 lb. more fruit per bearing tree or 4.31 lb. per tree.

When we compare the same variety under the two systems we get just as interesting results.

Variety	Cultivated section		Sod section	
	Number of trees producing	Yield average	Number of trees producing	Yield average
Wealthy	4	14.9 Lb.	4	55.0 Lb.
Jonathan	4	2.7 Lb.	14	4.1 Lb.
Wagener	2	1.9 Lb.	10	8.1 Lb.

In every instance a given variety produced more fruit in the sod section than in the cultivated section as the three varieties in the above table well illustrate.

Not only have they come into bearing sooner and for the first two years produced more fruit per tree, but also the trees themselves are larger and thriftier in the sod section than in the cultivated.

As a matter of caution it may be wise to stress that the above results do not mean that apple trees can be set in sod and allowed to shift for themselves in their fight for plant food and against weeds and grass. They cannot do this. Set out in sod, trees should have an annual spring application of nitrogen fertilizer and the weeds and grass should be mowed at least twice a year. The interesting thing to us at this farm is that it has been possible to grow apple trees up to bearing age so well without the labor of annual cultivation.

QUALITY APPLE BUTTER

L. M. MONTGOMERY

There is need among Ohio orchardists for ways and means of making increased and better use of their under grade apples at reasonably remunerative prices. This is true because of the necessity for relieving the market of a tremendous burden of windfalls, undersized, off color, and otherwise inferior tho probably wholesome fresh fruit.

The consumer is more and more demanding better quality commodities and manifesting a willingness to pay for them. The best grades sell the quickest and at more money, tho the price is directly borne down by the quantity of under grade product of like kind upon the market.

If our orchardists could find a profitable means of utilizing a still larger proportion of their under grade apples the price for the best grades would of course be increased.

In recent years the manufacture and sale of fresh and pasteurized cider has taken care of a large amount of the inferior apples, especially in the vicinity of the large markets and at roadside stands.

Another means of utilizing some of this off grade fruit is that of apple butter manufacture. The memory of the old fashioned apple butter like grandmother used to make still lingers appealing in the minds and tastes of many. But its almost black color, dense consistency, and the slow arduous process of manufacture have largely eliminated it from our tables in favor of a product manufactured by more modern methods.

The consumption of apple butter is being greatly stimulated at present by the superior quality of much of that produced by orchardists themselves for sale at their roadside markets. It seems that in Ohio an increasingly large quantity of apples could be disposed of in this form of product.

While the manufacture of good apple butter is an art, the average orchardist may readily grasp its fundamentals and secure good results. At the outset it must be borne in mind that the product can be no better in wholesomeness than the materials from which it is made. Therefore, the raw materials must be clean, sound, and free from serious insect injury.

The only mechanical method of practical value to the small manufacturer of a high quality product is one involving the use of

a steam jacketed copper or nickel kettle, a steam boiler of proportionate size, a simple pulping colander, a paring machine either hand or electrically operated, and a cider press. Scales for weighing the sugar and fruit and pulp, spoons, ladles, dippers, and funnels are minor articles needed.

The product may be stored in glazed earthen jars of convenient size and later dispensed in paraffined paper containers of pint and quart sizes, or it may be filled at once into suitable attractive glass jars and sealed while still hot.

There are three general methods open to the producer for the manufacture of apple butter. First, the butter may be made from apples and boiled down cider alone. Second, sugar may displace the cider entirely. Third, both cider and sugar may be used as the basis of manufacture. The first produces a butter too tart for most tastes. The second yields an over sweet product. While the third represents a combination satisfying to the great majority of consumers.

First wash the apples and allow to drain well. Then pare, trim and halve, quarter, or slice.

For each bushel of apples place four gallons of cider in steam kettle. Add the prepared apples and cook until mushy. Then run thru an apple butter colander or pulping machine to remove particles of core, seeds, skin, and fiber. Return the pulp to the kettle, add 6 to 9 pounds of sugar and cook down to a fairly thick consistency. Shut off the steam from the kettle and add spice to taste. A mixture of equal parts of ground cinnamon and cloves at the rate of one rounded teaspoonful per gallon of product will be about right for some tastes. The spices should be thoroly mixed with the concentrate by careful stirring after the cooking process is completed.

The resulting product should be a rich brown material of slowly flowing consistency of excellent quality, depending of course upon the variety or varieties of apples used.

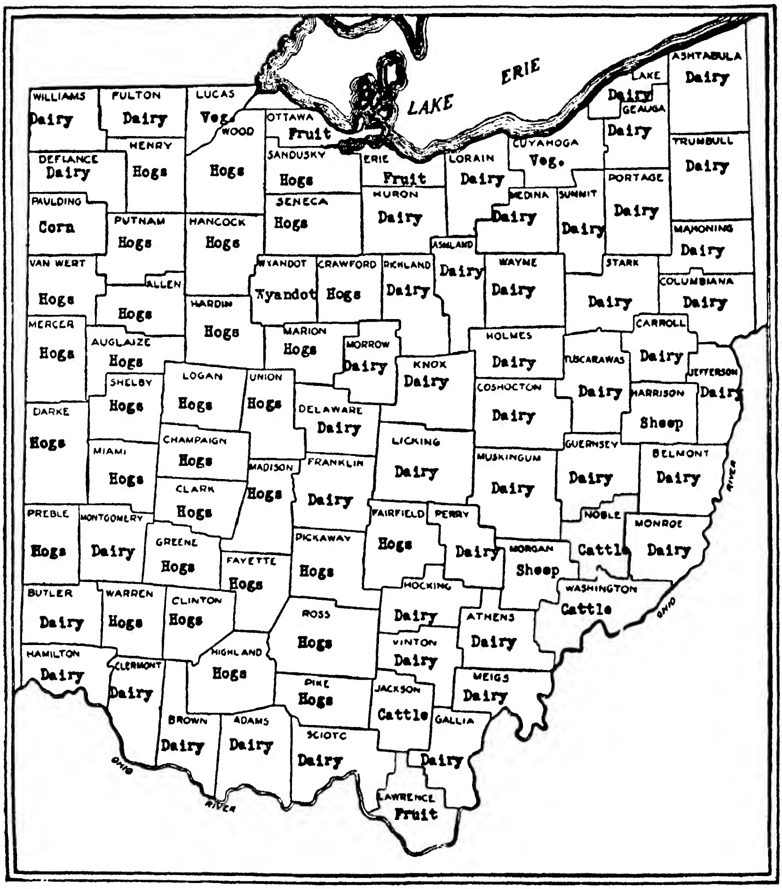
Commonly best results will be obtained by using a mixture of varieties of similar maturity but varying in acid and sugar content. A study and test of the suitability of numerous apple varieties is being made in the Horticultural Products Laboratory of the Ohio Agricultural Experiment Station to determine the relative merits of each for apple butter manufacture either alone or in combination. Either white or brown sugar or mixtures may be employed.

No water is used, as extra time will be required to remove it again from the concentrating material.

THE CHIEF SOURCE OF INCOME TO AGRICULTURE IN OHIO COUNTIES FOR 1927

J. I. FALCONER

The Station has recently published as Rural Economics Mimeograph Bulletin No. 22 an estimation of the gross cash income from the sale of agricultural products from Ohio farms by counties in 1927. This study shows the leading sources of agricultural income for each county. Dairying ranked first as a source of income for the State, and also in 45 counties. In 32 counties hogs ranked first; in 3, cattle; in 3, fruit; in 2, vegetables; in 2, sheep; and in 1, corn. The accompanying map shows the chief source of agricultural income thru sales in each county. Hogs predominate in the west and dairying in the east half of the State. The total income from sales for the State was $321,000,000.



ESTIMATED VALUE OF HOME-PRODUCED GOODS CONSUMED BY OHIO HOUSEHOLDS

V. R. WERTZ

Estimates of net income from the Ohio agricultural industry indicate that approximately one-third of the total net income to unpaid labor and capital engaged in Ohio agriculture is in the form of home-produced food and fuel consumed by Ohio farm households. The estimated value of such goods averaged 78 million dollars, or $322 per farm, during the five years, 1924 to 1928.

TABLE 1.—Estimated Value of Home-Produced Goods Consumed by Ohio Farm Households, 1924 to 1928

Year	Poultry and eggs	Dairy products*	Garden truck	Meats†	Fruits
	Dol.	*Dol.*	*Dol.*	*Dol.*	*Dol.*
1924	16,408,000	15,752,000	13,281,000	12,080,000	6,958,000
1925	18,147,000	16,142,000	16,404,000	15,745,000	6,734,000
1926	18,105,000	16,055,000	14,194,000	17,283,000	7,754,000
1927	16,352,000	16,881,000	16,806,000	15,090,000	7,754,000
1928	17,879,000	17,099,000	13,052,000	13,038,000	7,676,000
5-year average	17,378,000	16,386,000	14,747,000	14,647,000	7,375,000
Average per farm‡	71.81	67.71	60.94	60.52	30.48
Percent of total	22.3	21.0	18.9	18.8	9.4

Year	Fuels	Grains§	Syrup and sorghum	Honey	Total
	Dol.	*Dol.*	*Dol.*	*Dol.*	*Dol.*
1924	5,807,000	1,303,000	279,000	151,000	79,019,000
1925	5,934,000	1,708,000	271,000	142,000	81,227,000
1926	6,058,000	1,387,000	301,000	131,000	81,268,000
1927	5,398,000	1,315,000	282,000	121,000	79,999,000
1928	4,921,000	1,476,000	281,000	120,000	75,550,000
5-year average	5,625,000	1,438,000	283,000	133,000	78,013,000
Average per farm‡	23.24	5.94	1.17	0.55	322.37
Percent of total	7.2	1.8	.4	.2	100

*Milk and its products, does not include dairy cows and calves butchered on farms.
†Includes the larger meat animals—hogs, cattle, calves, and sheep.
‡Derived by dividing the average value of these goods consumed in Ohio farm households by the estimated average number of farms in the state during this 5-year period.
§Grains ground for use in farm households.

The accompanying table ranks the various groups of products contributing to the value of family living from the average Ohio farm during the five years. The first four groups—poultry and eggs, dairy products, garden truck, and meats—were of almost equal importance during this 5-year period. Poultry and eggs

accounted for 22.3 percent of the total value of home-produced goods consumed by Ohio farm households; milk and its products accounted for 21 percent of the total; garden products, 18.9 percent, meats 18.8 percent, fruits 9.4 percent, fuel 7.2 percent, and grains ground for use as human food, syrup, sorghum, and honey accounted for the remaining 2.3 percent.

During these five years the estimated value of home-produced and home-consumed poultry and eggs averaged $17,378,000, or $72 per farm. The value of home-produced milk and its products furnished Ohio farm households averaged $16,386,000, or $68 per farm. The value of meat animals—hogs, cattle, calves, and sheep—and garden truck each averaged slightly in excess of 14½ million dollars, or approximately $61 per farm. The value of home-produced fruits averaged $7,375,000, or $30 per farm; fuels $5,625,000, or $23 per farm; and grains ground for use in the household, syrup, sorghum, and honey made up the balance of $1,854,000, or $7 per farm.

FARMERS' PRODUCE MARKETS IN OHIO

WEEKLY PRESS BULLETIN

Farmers' produce markets in Ohio is the subject of a timely bulletin just published by the Ohio Agricultural Experiment Station. There is now an active interest in the marketing of farm products and the channels thru which foodstuffs are supplied to consumers have recently undergone numerous and far-reaching changes.

Some farmers' produce markets are strictly retail, others are strictly wholesale and still others are both. They are of two general types: the municipal market and the privately-owned market. The author, C. W. Hauck of the department of rural economics, finds that the farmer-owned markets in Ohio are growing in popularity.

There were six farmer-owned produce markets in the state in 1928. They were the Akron, Cincinnati, Cleveland, Newark, Portsmouth, Warren, and Youngstown markets. All were stock companies rather than cooperative enterprises, and all were of recent origin, the oldest having been established in 1916.

These six markets were thoroly studied in relation to other markets. Their facilities, equipment, management, problems and relative merits are discussed. All were successful financially. A copy of the bulletin will be mailed free upon request addressed to the Experiment Station at Wooster, Ohio.

TRACTORS REDUCE DEMAND FOR HORSE FEED

F. L. MORISON

The reduction in the amount of feed fed to farm horses during the time when tractors were being introduced most rapidly in Ohio is shown in the following table, taken from farm cost records kept in two counties in cooperation with the Rural Economics Department.

In 1920, when only 3 of the 31 farmers who kept records had tractors, an acerage of 2,936 pounds of grain and 3,772 pounds of hay was fed per horse. Along with the increased us of tractors on these farms there was a general decrease in the quantity of grain and hay fed per horse. In 1924, the last year that cost records were kept in these counties, 15 of the 32 farmers owned tractors. Bl that year the consumption of grain had fallen to 2,158 pounds and of hay to 3,083 pounds per horse.

TABLE 1.—Feed Consumed per Horse, Greene and Medina Counties, Ohio

Item	Pounds per horse				
	1920	1921	1922	1923	1924
Corn	2130	1887	1941	1714	1379
Oats	781	801	505	612	680
Other grain	25	29	65	38	99
Total grain	2936	2717	2511	2364	2158
Hay	3772	3839	3709	3396	3083
Stover	1905	1765	1930	2036	1593
Total roughage	5677	5604	5639	5432	4676
Feed cost per horse, dollars	372.76	70.36	65.75	62.24	56.93
Total farms, number	31	34	35	36	32
Farms with tractor, number	3	5	10	15	15

Using the 5-year average farm price of these feeds, ear corn at 85 cents per bu., oats at 56 cents per bu., other grain $1.50 per cwt., hay at $15 per ton, and stover at $4 per ton, the value of feed consumed per horse for each of the 5 years beginning with 1920, was $72.76, $70.36, $65.75, $62.24, and $56.93, a total reduction of nearly 22 percent in the 5 years. The two-year average feed cost for 1923 and 1924, when 44 percent of the farms had tractors, was one-sixth less than for the average of 1920 and 1921 when only 12 percent of the farms had tractors.

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

As for crops the year 1929 was much more satisfactory to Ohio farmers than either of the two preceding years. For the United States as a whole the 1929 composit yields of crops was 97.4 percent of the 10-year average, while for Ohio it was 99.4 percent. The Ohio corn production for 1929 was some 10 percent less than that of the 5-year average; wheat the same; and oats 20 percent less. Hay was 15 percent and potatoes 5 percent above; tobacco was nearly the same. Cover seed which has averaged 1.1 bushels per acre in Ohio the last ten years was reported as yielding 1.6 bushels in 1929. Prices, on the other hand, were no better than those of last year with a few notable exceptions such as potatoes and apples.

Trend of Prices and Wages, 1910-1914=100

	Wholesale prices all commodities U. S.	Weekly earnings N. Y. state factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm products prices	Ohio cash income from sales
1913	102	....	100	100	104	100	105	104
1914	100	100	101	102	102	102	105	109
1915	103	101	106	100	103	107	106	109
1916	130	114	123	117	113	113	121	119
1917	181	129	150	176	140	119	182	191
1918	198	160	178	100	175	131	203	242
1919	210	185	205	209	204	135	218	268
1920	230	222	206	205	236	149	212	225
1921	150	103	156	116	164	134	132	129
1922	152	297	152	125	145	124	127	127
1923	156	214	153	135	166	122	134	137
1924	152	218	154	134	165	118	133	139
1925	161	223	159	146	165	110	159	147
1926	154	229	156	136	170	105	155	156
1927	149	231	154	131	173	99	147	144
1928	153	232	156	139	169	96	154	134
1928								
January	151	230	....	137	158	....	141	139
February	151	230	....	135	....	....	141	127
March	150	233	155	137	....	....	145	126
April	152	227	....	140	172	96	152	127
May	154	230	....	148	....	....	167	135
June	153	232	157	145	....	....	163	142
July	154	230	....	145	173	....	162	132
August	155	231	....	139	....	....	158	119
September	157	234	155	141	....	....	158	121
October	153	234	....	137	174	....	153	139
November	151	233	....	134	....	....	146	151
December	151	237	....	134	....	....	147	151
1929								
January	152	234	156	133	166	....	144	141
February	151	236	156	136	....	....	149	133
March	153	239	156	140	....	94	155	134
April	152	237	155	138	163	....	150	138
May	150	236	155	136	....	....	152	140
June	151	236	154	135	....	....	153	147
July	154	235	154	140	172	....	157	163
August	153	237	154	143	....	....	159	153
September	153	240	154	141	....	....	152	138
October	151	....	....	....	174	....	150	138

CARE OF HOUSE PLANTS

W. W. WIGGIN

Potted plants growing in the house may be kept in a healthy condition during the winter months by careful attention to watering, temperature, ventilation, sunlight, and feeding.

The majority of house plants like a moist soil. Allowing the soil to become extremely dry each time before watering is not desirable. The plants should be given the proper amount of water each day to moisten the soil if needed. An excess of water, however, is very harmful. A hole for drainage should be provided in the bottom of the container. If the flower pot is placed in a jardiniere or saucer the water that drains from it must not be allowed to stand in the bottom of the container as it will water soak the soil. If the pot is placed on some material that holds it up from the bottom of the jardiniere it allows for drainage.

A temperature at night ranging from 55 to 70 degrees is satisfactory, but where the temperature drops nearly to the freezing point, the plants are severely checked. Plants are usually placed in or near windows during the day for sunlight. They should be removed to a warmer location for the night during cold weather.

Repotting house plants is often neglected. When the plant has filled the pot with a ball of roots it needs to be repotted. A good loam soil with an abundance of humus is satisfactory for most house plants. Feeding at frequent intervals with a liquid manure solution or nitrate of soda at the rate of a tablespoonful to a gallon of water will delay the necessity of repotting for a time. In repotting, small pieces of broken pot, stones, or some similar material shouıd be placed over the drainage hole in the bottom of the pot so that it does not become clogged. A plant should not be raised too rapidly in repotting. The use of a pot one-half to one inch larger than was formerly used is satisfactory. The roots develop more satisfactorily if this is done.

Gas escaping from the stove is very harmful to some plants and is often the cause of their turning yellow or making poor growth. Good ventilation is as essential to the health of the plants as it is to the human occupants of the house. Improper temperatures, lack of food material, or presence of gas are all noticeable by a yellowing of the foliage, and stunted plant growth similar to that shown by improper watering. If growth is not normal, one of these conditions is usually responsible.

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[1]In cooperation with College of Agriculture, Ohio State University.
[2]In cooperation with the U. S. Department of Agriculture.

NEW FACTS OF INTEREST TO OHIO FARMERS

New facts of practical interest to Ohio farmers and others will appear in 200 short articles in the 48th Annual Report of the Ohio Agricultural Experiment Station by Director C. G. Williams. "The aim of the report is to set forth briefly the work of the past year, together with such results as are ready for publication and have a practical bearing on Ohio agriculture in its largest sense."

The activities of the Station are divided among ten departments, each with a chief and staff of associates and assistants, as given on pages 30 and 31 of this bulletin. Each of these departments contributes new information from the results of its scientific research and experiments. The articles include field crops, vegetables, and fruits; the feeding and care of dairy and beef cattle, sheep, swine, and poultry; plant diseases and injurious insects and their prevention or control; studies in nutrition and the food value of dairy and other products; farm incomes, and expenses, marketing, and other economic subjects; forest planting, forest fires, wood utilization, and ornamental trees.

The district and county experiment farms contribute a dozen articles of general interest.

The report will be ready for mailing in four or five weeks, and will be sent without request to the libraries, vocational agricultural schools, and county agricultural agents of the State. It will be sent free to others upon request.

Many readers of the Bimonthly will want the Annual Report. In order that enough copies may be printed to go round without waste, the Station requests that those who wish a copy send in their name and address at once.

All requests should be addressed to The Ohio Experiment Station, Wooster, Ohio.

The Bimonthly Bulletin

Mar.-Apr., 1930 Number 143

Ohio Agricultural Experiment Station

CONTENTS

WOOSTER, OHIO, U. S. A.

Free Bulletin

C. G. Williams

Director

HENRY M. WACHTER, 1852-1929

On the establishment of the Southwestern Test Farm of the Ohio Agricultural Experiment Station, at Germantown, Montgomery, County, in the spring of 1903, Henry M. Wachter was chosen as its manager, a position which he held until his death on Christmas day, 1929.

Mr. Wachter was selected on the recommendation of the local Tobacco Growers Association, because of his interest in and expert knowledge of the handling of the tobacco crop, the establishment of the farm having been made possible by that Association. His qualifications for the work were not limited to a knowledge of tobacco culture. He possessed the further essentials of the investigator in scientific problems—unimpeachable integrity, open-mindedness, and painstaking carefulness in the execution of the details of his work.

The success of field experimentation in agriculture is even more dependent upon the execution than upon the planning of the work, for no matter how perfect the plan may be, the results may be destroyed or reversed by careless or unfaithful execution. For this reason the value of such work as Mr. Wachter did cannot be measured in money.

He has abundantly earned the title of "Faithful Servant of Agriculture."

Charles E. Thorne

STRAW MULCH FOR EARLY POTATOES

JOHN BUSHNELL AND W. E. WEAVER

Occasional reports of phenomenal yields of potatoes from the use of straw mulch have induced many growers to try this system in a small way. A very few have found it successful and are using it year after year. But many who have tried straw have failed to obtain the expected results and have given it up as impractical.

In the published records of experiments with straw mulch widely diverse results are reported. As an example, in the first three years of the Experiment Station, at Columbus, 1882 to 1884, a mulch was compared with cultivation on late potatoes and it proved detrimental for two seasons and decidedly beneficial the third. Similar results have been obtained elsewhere, and little or no explanation given.

It is well known that the potato thrives in a cool, moist climate. During June, July, and August the mean temperature in Ohio is too warm for the crop. Theoretically then, since a straw covering keeps the soil moist and cool, it should prove beneficial during these summer months. On the other hand, if the straw is applied early, detrimental effects may result from keeping the soil too cool during April and May, retarding germination and early growth, and possibly retarding nitrification in the soil as well.

With these ideas in mind, an experiment with straw mulch applied at different dates was conducted at the Hamilton County Experiment Farm. In this district, early potatoes are planted about April 1, and the mean air temperature reaches the optimum for potatoes (64° F.) about the middle of May. Presumably the soil temperature lags behind the air temperature, probably reaching the optimum for the crop by late May. In the experiment, one series of plots was mulched when planted; another early in May, just after the plants were up; and a third in late May when the plants were about a foot high. A uniform application of straw about 10 inches thick and requiring 10 tons per acre was used thruout. After this had been packed by the sprayer the mat was about 3 inches thick.

The first mulch, as anticipated, retarded germination and evidently retarded nitrification, for the plants not only grew slower but were lighter colored than those on the cultivated plots. But later in the season the plants recovered and the mulch appeared to

be beneficial. The yield from the strawed plots in 1928 was 14 bushels below the cultivated check plots, and in 1929, 48 bushels per acre above the checks, giving an average increase of 17 bushels per acre.

The second mulch, applied after the plants were up, was conspicuously successful, giving increased yields both seasons, with an average of 61 bushels per acre more than the cultivated plots. Up until the time of mulching these plots were harrowed and cultivated the same as the checks.

The late application, delayed until the plants were a foot tall, broke some of the leaves and buried many of them. The yields, therefore, were not as large as from the preceding mulch, in spite of the fact that theoretically this was an ideal time to apply straw. The average increase in yield was 39 bushels per acre above that of the cultivated plots.

TABLE 1.—Results With Straw Mulch Applied to Early Potatoes

Yield of marketable tubers in bushels per acre

Treatment	Planted Mar. 28, 1928*		Planted Mar. 25, 1929*		Average increase
	Yield	Increase	Yield	Increase	
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Cultivated check plots	135	....	275	....	....
Mulched when planted	121	−14	323	48	17
Mulched when plants were up	166	31	366	91	61
Mulched when plants were 12 inches	149	14	334	59	36.5

*Early Ohio used in 1928; Irish Cobbler in 1929.

The increases obtained in this experiment, particularly that from the second date of application, suggest that mulching may prove practical on a commercial scale if straw is available at a reasonable value. With reference to the saving in labor of cultivation, it is largely offset by the work of applying and removing the straw. If it were possible to harvest without removing the straw, a material saving could be credited, but in these experiments it was necessary to move the straw in order to operate a horse-drawn digger. Moreover, if the straw were left on the field and plowed in it might prove detrimental to the succeeding crop.

The relation of soil type to the effectiveness of the mulch was not a part of the experiment, but may also have a bearing on the success of mulching. The soil at the Hamilton County Farm is a silt loam, somewhat heavier than that commonly used for potatoes in that district. That the straw kept this soil too wet at times was evident at harvest in 1929, when the tubers from the straw plots

had enlarged lenticels. From this, one might predict that straw would be even more effective on sandier soil such as ordinarily used for potatoes, and conversely less effective on heavier soil.

Since it is probable that the beneficial results were due to the lowering of the soil temperature as well as conservation of moisture, equally large increases could not be expected in northern Ohio, where the summer temperatures are normally cooler.

Those who contemplate trying this method may feel that 10 tons of straw per acre is an excessive amount. It was found at Wooster that less than 10 tons would not keep down ordinary annual weeds, so that at least this amount should be used to insure all of the benefits of the mulch. Even the 10-ton application did not keep down perennial weeds, such as thistle and morning glory. Evidently straw should not be tried where perennial weeds are present.

The value of straw is the final consideration and the limitation to the practical application of this system of growing potatoes. Only where straw is at hand in large quantities at a relatively low value per ton is it likely to be used as a mulch on a commercial scale.

VARIATION IN WEIGHT OF CATTLE DUE TO "FILL"

PAUL GERLAUGH

Considerable variation exists in methods of handling cattle prior to weighing, that are sold in the country and weighed to the buyer at the farm.

Four lots of cattle that had been on experiment at the Station from June 18 to November 5 were handled differently as to their feed on November 6 and weighed at "daylight" on the 7th, to obtain information on variation in weights due to different methods of handling prior to weighing.

The cattle had been weighed each week while on test so that going over the scales caused no disturbance among them. The weights of November 4, 5, and 6, and estimated for November 7, were taken, starting at 8:30 a. m. after the cattle had been given their regular morning feed. Water was available in the lot.

The weights for the 4th, 5th, and 6th represent the closing weights of the feeding test and are averaged together for the final

weight of the test, November 5. The estimated full weight of November 7 is obtained by adding twice the average daily gain to the November 5 weight.

TABLE 1.—Showing Variation in Weight of Cattle Due to Different Methods of Handling Prior to Weighing*

Weights taken 8:30 a. m. Cattle fed at 6:30 a. m. and water available					Weights		Variation between actual empty and estimated full weights
					Estimated	Actual*	
Lot	Cattle	November 4	November 5	November 6	November 7	November 7 6:30 a. m.	
No.	*No.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Pct.*
1	16	1016	1016	1021	1022	998	−2.35
2	16	994	994	1001	1000	979	−2.10
3	17	986	985	989	990	994	+.41
4	17	989	986	987	991	985	−.61

*Lots 1 and 2 were not fed evening of November 6. Lots 3 and 4 given regular feed evening of November 6. Water removed from Lots 1, 2, 3, and 4 at 6 p. m. November 6.

On the evening of November 6 Lots 1 and 2 were not given any feed. Lots 3 and 4 were given their regular evening ration, consisting of 7 pounds of shelled corn and protein supplement, 7 pounds of silage, and ½ pound of hay. The water supply of all four lots was removed at 6 o'clock the evening of the 6th. The cattle were weighed on the 7th, starting at 6:30 a. m.

The variation between the actual empty weight of November 7 and estimated full weight of the same date is not as great as is frequently anticipated.

MINERALS IN THE WINTER RATION FOR PREGNANT AND NURSING EWES

D. S. BELL

Three comparable lots of purebred C-type Merino ewes were placed on test during each of the last three successive winters (1925-26, 1926-27, and 1927-28) to determine the effect of adding minerals to the winter ration of pregnant and nursing ewes. The ewes in each lot were fed a basal ration of mixed grain—3 corn, 3 oats, 1 linseed oil cake—alfalfa hay according to appetite, 2 pounds of corn silage, and salt free-choice. From the time the tests were begun in December until the ewes commenced lambing in February, the grain mixture was fed at the rate of 0.5 pound for

each 100 pounds live weight of the ewes in the respective lots. A gradual increase in the amount of grain fed was made during the lambing period, so that when the last lamb arrived and the ewes were started on what was termed the nursing period the ewes received 1.1 pounds of grain for each 100 pounds of body weight. This ration, without additions, constituted the feed allowance for Lot 1 ewes, which were designated as the check lot.

TABLE 1.—Minerals in Winter Ration for Pregnant and Nursing Ewes

Average of 3 experiments: 1st experiment, Dec. 23, 1925 to May 12, 1926 2d experiment, Dec. 15, 1926 to Apr. 27, 1927 3d experiment, Dec. 20, 1927 to Apr. 24, 1928	Lot 1 Basal ration no added minerals	Lot 2 Basal ration of ⅓ oz. added minerals per ewe daily	Lot 3 Basal ration access to minerals
Ewes:			
Average number of days on test	133	133	133
Number of ewes at start	60	60	60
Number of ewes lambing	55	56	59
Average weight of ewes at start	107.5	107.5	108.6
Average weight of ewes just before lambing	131.3	131.1	132.3
Average loss in weight by ewes due to lambing	18.2	19.5	17.5
Average loss in weight by ewes while nursing	1.07	2.65	1.09
Average ration:			
Grain mixture,* pound	.89	.89	.90
Alfalfa hay, pounds	2.15	2.15	2.14
Corn silage, pounds	1.99	2.00	2.00
Mineral mixture, ounce	....	.33	.034§
Salt, pound	.055	.056	.052
Lambs:			
Number of lambs born	64	67	67
Number of lambs raised	60†	62‡	62‡
Average weight of lambs at birth	7.99	8.36	8.18
Average increase in weight first 10 days	3.93	4.46	4.30
Average increase in weight to close	23.41	23.62	23.80
Average age of lambs at close (days)	62	63	63
Average ration:			
Grain mixture,* pound	.15	.15	.15
Alfalfa hay, pound	.23	.23	.22
Minerals, ounce	....	....	.063

*Consisted of 3 parts corn, 3 parts oats, 1 part linseed oil cake—parts by weight.
†Two lambs born dead; 2 lambs died.
‡One lamb born dead; 2 died; 2 removed.
§Lambs largely responsible for this intake of minerals charged to ewes.

Lot 2 ewes were fed, in addition to the basal ration, ⅓ ounce per ewe daily of a mineral mixture. This mixture, which was fed on the silage, was composed of 2 parts ground limestone, 2 parts special steamed bone meal, and 1 part salt, plus 1 ounce of potassium iodide for each 100 pounds of the mineral mixture.

The ewes of Lot 3 were given, in addition to the basal ration, access to a box containing the mineral mixture in order to determine whether pregnant and nursing ewes had any desire to take additional minerals.

The results showed that the ⅓ ounce of minerals added to the ration of each ewe had no measurable effect upon the health, vigor, or condition of these ewes when compared with those not given

added minerals. This applies equally to the three tests and for the three periods of late pregnancy, lambing, and nursing covered by each test.

The lambs from the mineral-fed ewes, Lot 2, averaged 0.37 pound heavier at birth than the lambs from the check, or no-added-mineral, lot. This heavier birth-weight, however, increased the percentage of difficult lambing from 14 percent to 39 percent, and called for a corresponding increase in attention by the shepherd to see that the lambs arrived safely and without undue delay.

Additional minerals had no measurable effect upon the vigor or condition of the lambs at birth or at subsequent ages. A slightly greater increase in weight during the first 10 days after birth was recorded for the lambs from the mineral-fed ewes. However, this difference in rate of gain disappeared by the time the experiment closed, when the lambs averaged about 63 days old. The result of the trials showed that at weaning time there was no difference between the lambs, one lot with another.

The ewes of Lot 3, having access to the mineral mixture, did not manifest any appetite for added minerals. The figures in the table show some intake of minerals by the ewes, but this must be attributed to the young lambs, which, after they reached about 3 to 4 weeks of age, ate freely of the mineral mixture. But since this intake of minerals did not affect the rate of gain in weight made by the lambs, it remains an open question as to what prompted the act.

The potassium iodide in the mineral mixture was sufficient, apparently, to prevent goiter or big-neck in lambs at birth. None of the lambs from Lot 2 ewes showed any trace of enlarged thyroids, while one lamb from Lot 1 and three lambs from Lot 3 evidenced slightly enlarged thyroids, all of which disappeared without treatment. Where goiter or big-neck in lambs at birth is common the sheep raiser should provide the pregnant ewes with iodine in some form.

In summarizing the results of the three tests it seems that aside from the goiter problem, if ewes are well fed and the ration contains a liberal allowance of legume hay, little if any benefit will be derived from the addition of minerals to the winter ration for pregnant and nursing ewes.

REMAKING A SEMI-MONITOR POULTRY HOUSE

D. C. KENNARD AND V. D. CHAMBERLIN

There is no one best kind of poultry house, but the semi-monitor type may well be considered as one of the most objectionable kinds. The probable reason this type of house became popular twenty years ago was that its appearance appealed to many and that plans for the more recent and better houses were not available at that time.

Surely no one who is familiar with its objectionable features and realizes that it is 20 years out of date would consider building a semi-monitor house.

Only three objections need be mentioned. The semi-monitor is hot in summer; cold in winter; and it is difficult, if not impossible, to ventilate properly in winter. Consequently serious trouble has often been experienced with colds, roup, and bronchitis in such houses. These statements are based on eight years experience at the Ohio Experiment Station with four semi-monitor poultry houses built years ago, with a total capacity of 1200 layers. These houses were compared directly with the later and better types of poultry houses. In addition to this the writer has observed many similar experiences on the part of poultry keepers. A frequent inquiry coming to the Ohio Station from all parts of the country is how to remodel a semi-monitor house so as to make it more comfortable and ventilate it so as to prevent colds and roup. The Station is now able to answer such inquiries from experience, since it has converted all its houses of this type so they are comfortable and highly satisfactory.

STRAW LOFT FOR SEMI-MONITOR POULTRY HOUSE

When it is desired to involve the least possible expense in altering a semi-monitor house, a very satisfactory procedure is to put in a straw loft, as illustrated and described in the Bimonthly Bulletin for May-June, 1926; or the house can be ceiled with matched lumber or insulating board in the place of the slats. In this case a ventilator running the entire length of building as shown in Figures 1 and 2 should be provided. The objection to a straw loft is that it may become a harbor for rats. However the straw can be supported by removable frames made of 1 by 3 inch material covered with 1 inch mesh poultry netting which prevents the rats from entering the loft.

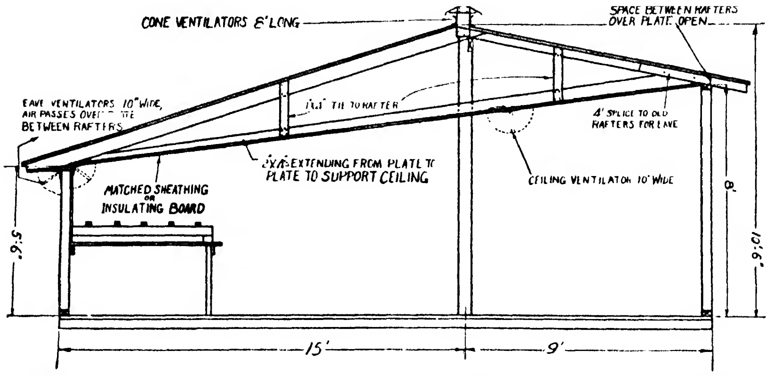

Fig. 1.—Front to rear section of remodeled semi-monitor poultry house, showing combination type roof and ventilator in comb of roof

By allowing some open window space above the loft for air outlet the air from below gradually filters thru the straw and provides one of the most desirable means of ventilating a poultry house.

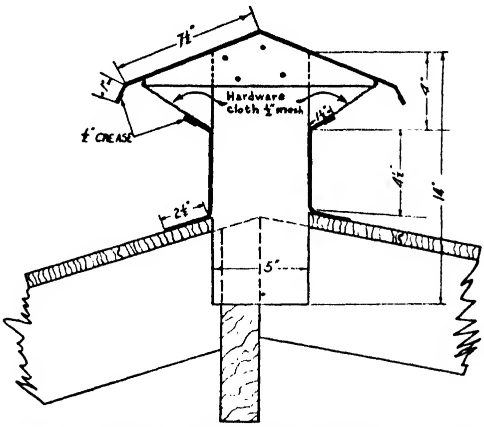

Fig. 2.—Cross section of ventilator in roof

The straw absorbs some moisture from below and tends to keep the house warm and make it more dry. In summer the straw loft insures a much cooler house. The straw needs to be only 6 or 8 inches thick, and may not need to be changed until after two or three years, if free from rats. The incoming air is admitted thru lower front window or open front spaces.

CONVERSION OF SEMI-MONITOR TO COMBINATION TYPE ROOF

Where a permanent and more satisfactory job is desired the semi-monitor roof can be converted into a combination type of roof. Figure 3.

This 24 by 100 foot semi-monitor poultry house was remodeled at a nominal cost of material, since the rear part of roof remained undisturbed and the front roof span was cut in sections and elevated to its present position. This required only short rafter extensions, and a small amount of additional sheathing. The front was raised 30 inches higher than before and additional windows put in the upper space without changing the lower ones.

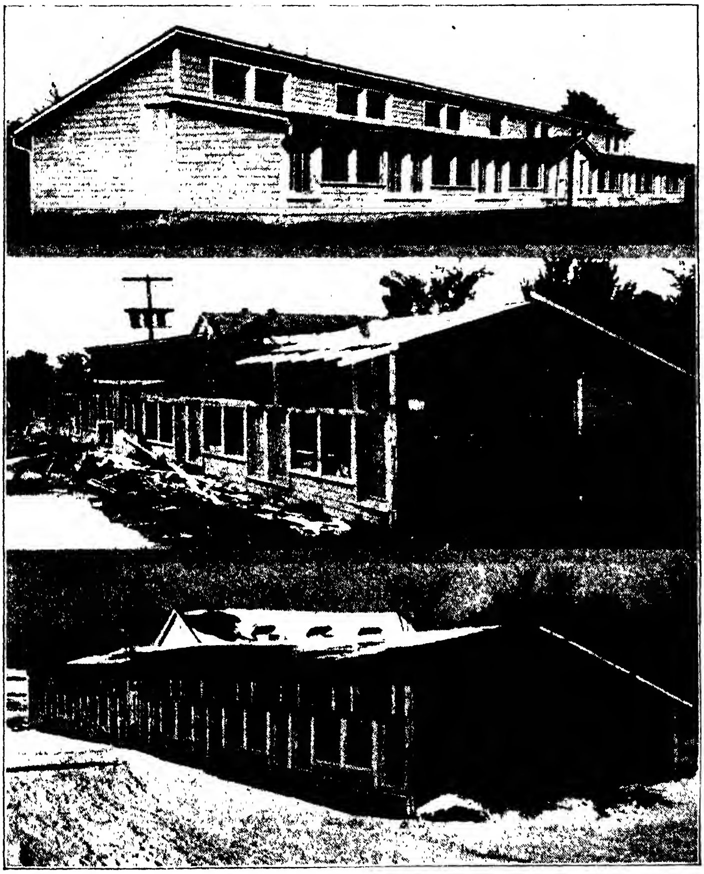

Fig. 3.—The Station semi-monitor poultry house before remodeling (top). Elevating the front roof span (middle). The remodeled house showing additional windows in upper front (bottom).

Before remodeling, this semi-monitor house was most unsatisfactory, whereas afterwards it is proving highly satisfactory, since ventilation can now be effectively controlled and the house can be kept comparatively comfortable both winter and summer.

FERTILIZING TIMOTHY MEADOWS WITH NITRATE OF SODA

MORGAN W. EVANS*

In farm practice it is the custom to use commercial fertilizers on the cultivated and cereal crops in the rotation rather than on the timothy meadows. Farm manure is occasionally applied on meadows from which one or more hay crops are to be harvested, tho the more common method is to plow it under for a crop of corn.

Timothy, however, like other crops, is capable of responding to fertilizers applied on the soil. Increased yields of hay are secured especially from those fertilizers, such as nitrate of soda, that carry nitrogen. It is largely the nitrogen in farm manure applied on the meadows that produces larger yields.

For a number of years the effects of different kinds of fertilizers upon timothy meadows were studied, at the Timothy Breeding Station at North Ridgeville, Ohio. In these experiments the effects of nitrate of soda, especially, were determined.

This experiment station is conducted cooperatively by the Ohio Agricultural Experiment Station and the United States Department of Agriculture.

RELATIVE EFFECTS OF DIFFERENT KINDS OF FERTILIZERS

During the 10-year period from 1918 to 1927, inclusive, different commercial fertilizers were applied annually and farm manure was applied both annually and in alternate years, on a series of plots in a timothy meadow. Check plots on which no fertilizers were used were left at intervals in the series. Table 1 is a record of the average annual yields of hay obtained from the duplicate plots fertilized in each way. The increase in yield from each method of fertilization, determined by comparing the yields from the fertilized plots with those of the nearest unfertilized check plots, is also shown in the same table.

During the early part of the experiment there was a large growth of practically clear timothy in the plots fertilized with nitrate of soda alone. Nitrate of soda likewise produced much larger increases in the hay yields than did superphosphate for first

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few years, but this was reversed the last few years of the experiment. In the plots where superphosphate was used alone volunteer alsike clover appeared after the second year, more in some seasons than in others, but always in larger proportions than in the plots where nitrate of soda only was used.

TABLE 1.—Timothy Hay: Average Yield and Increase per Acre From the Use of Fertilizer or Manure, for the 10-year Period, 1918 to 1927

Treatment	Amount	Frequency	Air-dry hay per acre	
			Yield	Increase from treatment
	Lb. or T.		*Lb.*	*Lb.*
Nitrate of soda	120	Annually	3180	793
Superphosphate, 16%	240	Annually	2916	571
Nitrate of soda Superphosphate, 16%	60 120	Annually	3227	861
Nitrate of soda Superphosphate, 16%	120 240	Annually	3559	1091
Nitrate of soda Superphosphate, 16% Muriate of potash	120 240 80	Annually	3731	1306
Farm manure	5	Annually	3264	891
Farm manure	5	Biennially	3005	617
Farm manure	10	Biennially	3093	604

At all times during the experiment larger increases were obtained from the use of both nitrate of soda and superphosphate than from either fertilizer alone at the same rate. Where potash was used in addition to nitrate of soda and superphosphate, larger increases in yields were obtained than where only one or both of the other fertilizers were applied. At the close of the experiment the plots fertilized with both nitrate of soda and superphosphate, and with all three elements, had better stands of timothy plants and a smaller number of weeds than the unfertilized plots.

Farm manure produced smaller yields than the combination of 120 pounds of nitrate of soda and 240 pounds of superphosphate, or than these in combination with muriate of potash. The manure not only produced increased yields but it maintained a better stand of timothy than no treatment. At the close of the experiment there were no more weeds in the manure plots than in the unfertilized plots, tho the percentage of weeds was a little higher in plots where farm manure was applied than where nitrate of soda and superphosphate, were applied with or without potash.

NITRATE OF SODA AT DIFFERENT RATES

Nitrate of soda applied over a long period of years did not continue to produce as large increases in hay yields as some other fertilizers. In new meadows with a good stand of timothy, however, any nitrogen carrying fertilizers, such as nitrate of soda, was quite effective.

TABLE 2.- -Timothy Hay: Yields per Acre From Applications of Nitrate Soda at Various Rates

Nitrate of soda per acre	Air-dry hay per acre			
	1924	1925	1926	Average
Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*
0	3468	1534	2546	2516
40	3864	1676	2852	2798
80	4016	1920	3082	3006
160	4462	2100	3758	3440
320	4912	2196	4122	3744

Nitrate of soda was applied for three seasons at several different rates on triplicate plots in a timothy meadow. The results are shown in Table 2. The average results for the three years are presented in graphical form in Figure 1.

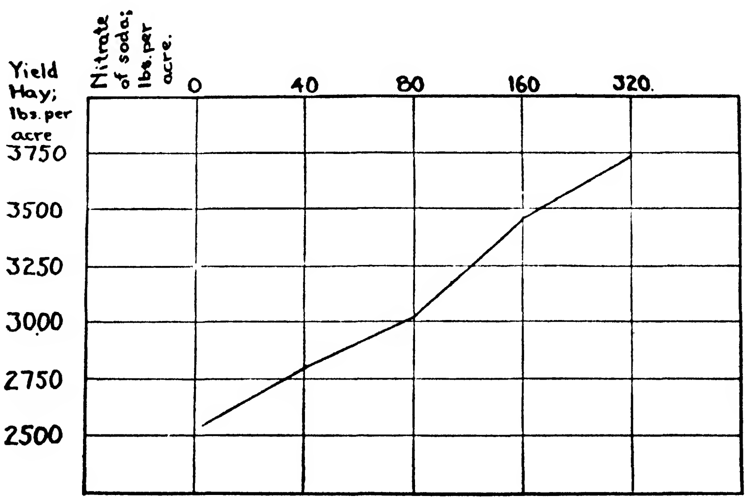

Fig. 1.—Showing average yields of timothy for 1924-1926 on unfertilized plots and plots receiving 40, 80, 160, and 320 pounds of nitrate of soda per acre

During the spring of 1924, there was an excessive amount of rainfall and the growth of timothy was unusually large. Conditions were reversed in 1925 and the yields of timothy were

unusually small. In 1926, the rainfall during the spring was nearly normal, and the yields of hay were considerably larger than in 1925. The close correlation between yields of hay and rainfall during April, May, and June may be observed by comparing Tables 2 and 3. The increases in the yields of hay produced by the fertilizer as well as the total yields were larger in years of normal or above normal rainfall than in years when there was a comparatively light rainfall during the spring months. The U. S. Weather Bureau Station at Cleveland, where the rainfall records were obtained, is located about 20 miles from the Timothy Breeding Station.

TABLE 3.—Spring Rainfall for the Three Years of the Preceding Experiment Compared With the 58-year Average of the U. S. Weather Bureau, Cleveland, Ohio

	1924	1925	1926	Average, 1871-1928
April	2.85	1.37	3.44	2.45
May	2.62	2.24	1.48	3.09
June	5.73	1.81	2.58	3.24
Total	11.20	5.42	7.50	8.78

The results presented in Table 4 illustrate the general principle of economics known as the law of diminishing returns. F. A. Fetter in The Principles of Economics describes the operations of this law as follows: "If a certain value in labor, fertilizer, or material be applied to an acre of land, it may be more than recovered in the value of the produce. Further applications give a product increased not in equal proportion to the former yield, and so on till the value of the last-added agent just balances that of the added product." When 40 pounds of nitrate of soda per acre was applied, the increase of hay was 282 pounds; when 80 pounds was applied, the increase from each unit of 40 pounds was somewhat less; when 160 pounds per acre was applied, the increase for each 40-pound unit was still less; and when 320 pounds was applied the average increase for each unit of 40 pounds was not much more than one-half of the increase from the 40-pound application.

TABLE 4.—Average Increase in Hay From Each Unit of 40 Pounds per Acre of Nitrate of Soda*

Rate of applications of nitrate of soda; lb. per acre	Units of 40 lb.	Total increase in hay	Average increase in yield per unit
	No.	*Lb.*	*Lb.*
0	0	....	....
40	1	282	282
80	2	490	245
160	4	924	231
320	8	1228	153.5

*An application of 40 pounds per acre equals one unit; 80 pounds two units; etc.

Based on the market values of the fertilizer and of the hay on the farm the results show that the profits from the use of the fertilizer on timothy meadows were not great. In the following calculations, nitrate of soda is valued at $65 per ton; 16 percent superphosphate at $21; muriate of potash at $50; farm manure at $1; and hay on the farm at $12 per ton.

The cost of the fertilizer per year where nitrate of soda was applied annually for the 10-year period was $3.90 per acre, and the farm value of the increase in hay was $4.76, leaving a balance of $0.86 per acre. Applications of 120 pounds of nitrate of soda and 240 pounds of superphosphate cost $6.42 per acre, and the value of the increase in hay yield was $6.55, leaving a balance of $0.13 per acre. When 80 pounds per acre of muriate of potash was added to the other two fertilizers, the cost was $8.42 per acre and the value of the increase $7.84, a loss of $0.58 per acre. The increase from 5 tons of farm manure valued at $5 was $5.35 per annum, a profit of $0.35 per acre. When the cost of applying the fertilizer and of harvesting the increase in crop of hay is included, the profits from any method of fertilization used disappear.

CONCLUSIONS

The yields of hay in timothy meadows may be increased by the use of farm manure or by properly selected commercial fertilizers. The nitrogen-carrying fertilizers, such as nitrate of soda, are especially effective. However, if superphosphate is used in combination with the nitrate of soda, the ingredients supplied in the fertilizer more nearly replace those removed by the crop. The yields of hay were still further increased by the addition of muriate of potash, but owing to the relatively high cost of this fertilizer the application on timothy meadows was hardly practical. An application of 100 to 150 pounds of nitrate of soda in combination with 100 to 250 pounds of superphosphate per acre is suggested for most conditions under which timothy meadows are to be fertilized.

From these experiments it is apparent that the application of fertilizers at the present price on meadows used for the production of timothy hay for market at $12 or less per ton would not be practical.

If the farmer is growing the timothy hay for use on his farm, and he purchases part of the hay he uses, then the value of the increased yield of hay should be compared with the cost of purchased hay delivered at his farm, and not with the estimated farm value of hay grown for market. Timothy hay grown and harvested

under favorable conditions and fed in suitable rations, has a higher feeding value for dairy cows and other stock than timothy hay of a lower grade fed under less favorable conditions. The advisability of fertilizing timothy meadows, therefore, is a problem which each farmer can best decide for himself, according to his own needs and according to his own local conditions.

EXPERIMENTS IN CONTROLLING APPLE SCAB WITH DUSTS

CURTIS MAY AND H. C. YOUNG

Many orchardists in Ohio have tried to use dusts of one kind or another to control apple scab. The degrees of success that have attended these attempts in the past have varied widely. During some seasons good results were secured only to be followed by failures the next year. Several factors have contributed to this variability. Chief among these were the kinds of dust used, the number of applications necessary to secure control in a given season, weather conditions, and the timing of the applications.

In some years apple scab is very difficult to control, in other years it may be held in check by a spraying or dusting schedule that would certainly fail to control a severe attack. Weather conditions during the early part of the season largely determine the severity of the outbreak. Frequent periods of rainy weather in the spring favor the development of the fungus causing this disease. On the other hand, dry springs are unfavorable for its growth and for primary infections of the leaves and young fruits. In this respect the season of 1929 with its frequent periods of precipitation was exceptionally favorable for scab. Consequently a larger number of applications of fungicide than usual was necessary. In 1928 seven dustings gave good control of scab in the Bingham orchard at Chardon; in 1929 ten applications were necessary to control the disease on McIntosh at the Neal orchard at West Richfield.

Rains, in addition to their favorable effect on the development of apple scab, wash the dust from the leaves, making it more difficult to secure good control in a rainy season. In the work at the Neal orchard the amount of sulfur remaining on the leaves after each rain period was determined and when it had dropped below 0.7 mg. per square inch of leaf surface the trees were dusted again ahead of the next infection period.

Pre-bloom infection periods were predicted by observation of the development, on the dead leaves of the fungus causing the disease and with the aid of the regular weather forecast furnished the Spray Service. After the danger of infections from ascospores discharging from the over-wintered leaves was past and the new scab lesions began to appear on the young leaves, dusts were applied ahead of predicted rain periods unless sufficient dust still remained on the leaves to protect them from infection.

Since the results of previous years' experiments have shown that the ordinary commercial dust combinations cannot be relied upon to give control under all conditions, it has been necessary to develop better materials. Some of the dusts tried out in 1928, a season favorable for scab, gave very good control of the disease, and they were used again in 1929, and in addition several other dust combinations that might be expected to be of value. The toxicity of the dust to fungi and its ability to stick to the leaves are of prime importance. The adhesiveness of certain dusts to apple leaves after various amounts of rain had fallen on them has been determined. The results are given in Table 1.

TABLE 1.—Percent of Sulfur Present on Apple Leaves After Various Amounts of Rainfall

Date applied Leaves collected Inches rainfall	Apr. 25 Apr. 26 0.64	Apr. 30 May 2 0.16	Apr. 30 May 6 1.31	May 7 May 10 None	May 7 May 12 0.28	May 7 May 14 1.20
Materials	Percent sulfur remaining on leaves					
90—10 sulfur-lead arsenate	15.9	....	33.2	60.0	43.5	32.3
85—15 sulfur-dry lime-sulfur	27.6	43.3	22.2	91.5	44.0	....
90—10 sulfur manganar	34.4	58.8	33.2	80.4	43.5	30.1
85—10—5 sulfur manganar-aluminum hydrate	36.8	64.8	39.8	81.8	43.0	49.6
Spray 3½ lb. dry lime-sulfur to 50 gal. water	52.8	85.6	42.8	87.1	....	37.4

Dry lime-sulfur spray, 3½ pounds to 50 gallons of water, in all cases stuck to the foliage better than any of the dusts. After 0.64 inch of rain, about one-half of the sulfur in the spray material remained on the leaves as compared to about 37 percent of the best dust. After 1.31 inches of rainfall, the percentage of sulfur remaining on the leaves from spray and dusts was more nearly equal. The addition of aluminum hydrate to the sulfur-manganar increased its adhesiveness to some extent.

The distribution of the dust on the leaf both before and after a rain is of considerable importance. Figure 1 shows the effect of a rain of 0.16 inch on the distribution of a 90-10 sulfur-lead arsenate

dust. Practically all of the dust was washed from the central section of the leaf and from the margin except the portion near the tip and base. It is evident that only a small part of the leaf was protected from fungus invasion after the rain. It is very likely that sprays not only stick better than dust, but are distributed more evenly over the surface of the leaf after they have been washed by rain.

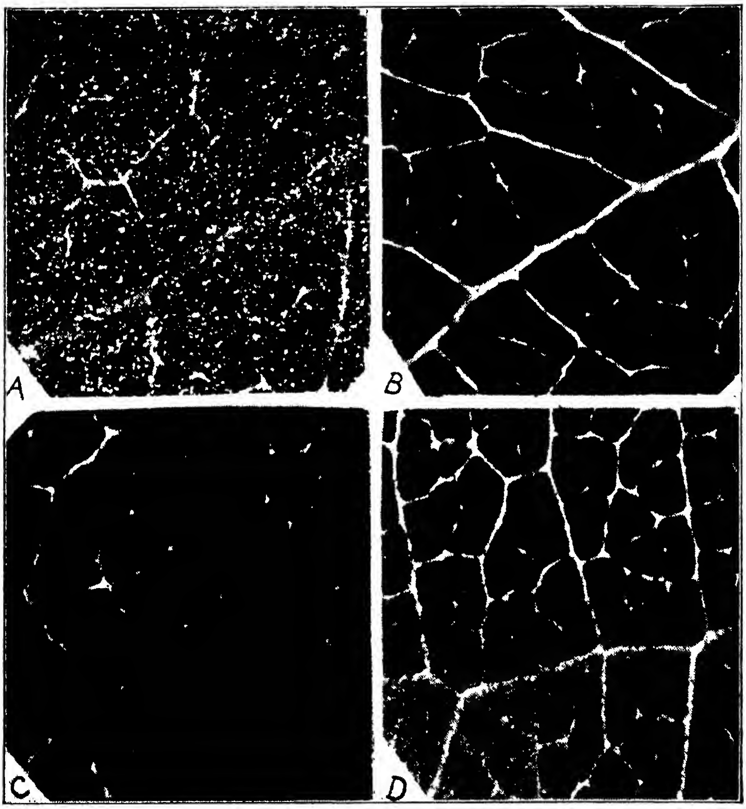

Fig. 1.—Photographs of sections of apple leaves showing the distribution of dust particles when first applied, and after a rain of 0.16 inch

A, section of central portion of leaf just after dusting; B, central portion of leaf; C, tip of leaf; and D, margin of leaf, after 0.16 inch of rain

The results of the field experiments in several orchards are summarized in Table 2.

The 85-15 sulfur-dry lime-sulfur and the 90-10 sulfur-manganar dusts gave the best results. Better control was secured in some orchards than in others, due to the varieties of apples used

TABLE 2.—Summary of Results of Field Tests With Sulfur Dusts in Controlling Apple Scab

Material	Grade A	Below grade A		
	Scab free and slight scab Pct.	Moderate scab Pct.	Severe scab Pct.	Total scab Pct.
Bingham Orchard, 1928, Stayman Winesap				
Commercial dusting sulfur	78.2	17.4	4.4	21.8
Sulfur, 300 mesh	76.1	15.5	8.4	23.9
96-4 sulfur-manganar	93.1	4.8	2.5	6.9
85-15 sulfur-dry lime-sulfur	95.6	2.2	2.2	4.4
Check	0.5	1.0	97.5	98.5
Taite Orchard, Delaware, 1929, Rome Beauty				
Dry lime-sulfur spray 3½-50	98.2	0.6	1.2	1.8
85-15 sulfur-dry lime-sulfur	87.0	9.1	3.9	13.0
90-10 sulfur-manganar	82.5	12.2	5.5	17.5
Commercial dusting sulfur	78.0	20.0	2.0	22.0
Check	....	....	....	98.0
Mantle Orchard, Painesville, 1929, Rome Beauty				
Dry lime-sulfur 3½-50	99.0	1.0	....	1.0
85-15 sulfur-dry lime-sulfur	98.5	1.5	....	1.5
90-10 sulfur-manganar	98.9	1.1	....	1.1
Commercial dusting sulfur	96.0	4.0	....	4.0
Neal Orchard, West Richfield, 1929, McIntosh				
Dry lime-sulfur spray 3½-50	88.4	6.8	4.8	11.6
85-15 sulfur-dry lime-sulfur	85.4	13.0	1.6	14.6
85-10-5 sulfur-manganar-aluminum hydrate	61.1	32.3	6.6	38.9
90-10 sulfur-manganar	54.0	25.1	20.9	46.0
90-10 sulfur-lead arsenate	23.1	40.6	36.3	76.9
Check	....	....	100	100

in the test and to local differences in the intensity of the disease. In view of these and other experiments the following general recommendations are suggested.

1. Sulfur dusts, such as 85-15 sulfur-dry lime-sulfur and 90-10 sulfur-manganar, may be substituted for sprays during the pre-blossom period. These dusts controlled scab almost as well as sprays.

2. When scab has been held in check in the pre-blossom period mild sprays or dusts may be used in subsequent applications.

3. Dusts without poison may be used for blossom applications. Frequently scab spores are discharged during bloom and an application of dust may insure control.

4. Dust applications should be carefully timed and applied frequently during rain periods, and sometimes immediately after heavy rains.

5. Dust both sides ahead of infection periods.

6. Use the best dust obtainable. The finer the dust the better it will stick.

THE CHRISTMAS TREE INDUSTRY

EDMUND SECREST

The use of evergreen trees at Christmas is an age-old custom, which has increased materially during the last ten years. Heretofore the supply of trees for Ohio has come largely from the native forests of New England, Michigan, and Canada. Of late years some few landowners in Ohio have been growing stock for the Christmas market at good profit.

Trees imported from the north woods are cut two months before Christmas. They lose their fragrance, and a few days after contact with the warm air of houses the foliage falls from the branches. In consequence of obvious superiority, home-grown trees are in demand and command a higher price.

SPECIES FOR CHRISTMAS TREES

Several species of evergreens may be used for Christmas trees. The spruces are the most popular and, for the State as a whole, the best adapted for planting. For plantations of considerable size it may be well to vary the planting somewhat between the different species. A description of species follows in order of their importance.

Fig. 1.—Planting of Douglas fir and Fraser's fir

Norway spruce is the most widely used at the present time for Christmas trees and the most dependable. Growth is rapid, form excellent, and foliage a dark green. It is easily transplanted and planting stock costs less than any other species in use.

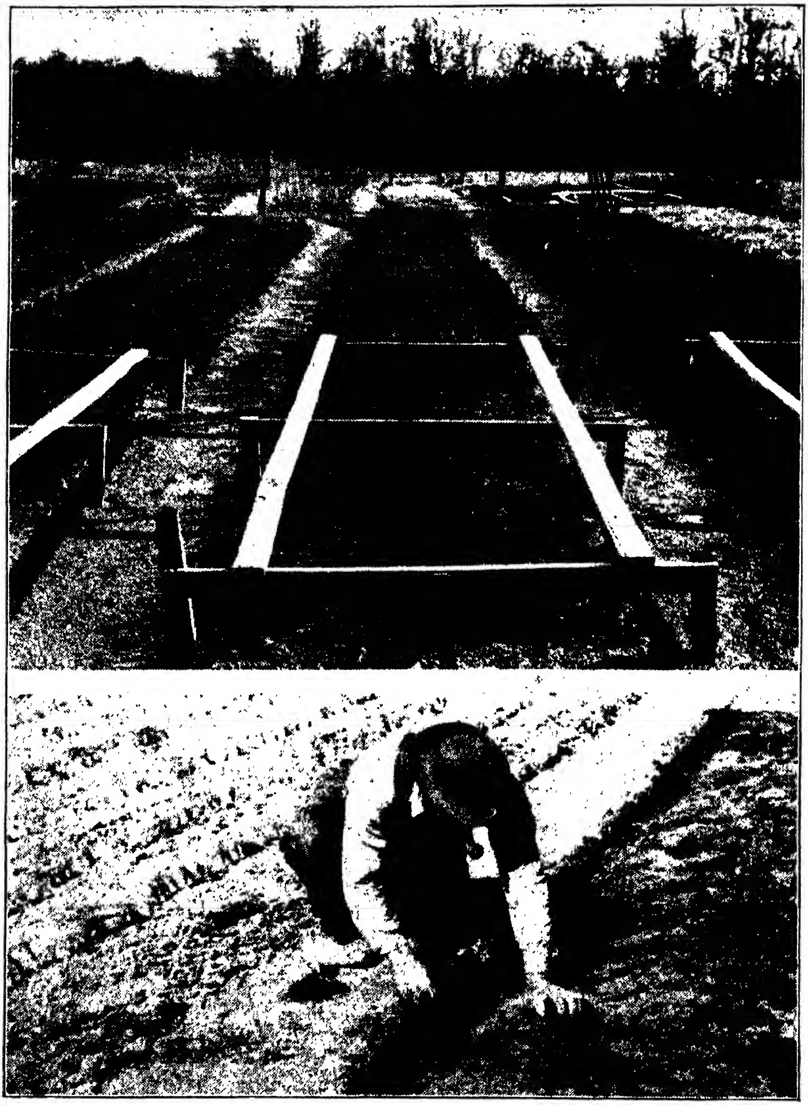

Fig. 2.—One and two year old seedlings of Norway spruce, above
Illustrating cleft method of transplanting seedlings in
nursery rows, below

White spruce grows much like the Norway and in northern Ohio has about the same rate of growth. The foliage has a silvery cast which is very pleasing. The stock is not as commonly grown in nurseries, and is slightly more expensive than Norway spruce.

Douglas fir is a very handsome tree of good form. The blue forms have very pleasing soft foliage. It does not grow quite as fast as the Norway spruce but is adapted to all sections of Ohio. Planting stock as a rule costs a little more than the spruce, and it is a little more difficult to transplant than spruce. It is worth planting for Christmas tree use.

Balsam fir.—This is also a handsome evergreen that comes from our north woods. It is not as adaptable for general planting as the above named species. It may be used north of the latitude of Columbus. Planting stock is more expensive, and the growth is somewhat slower than the others.

Hemlock is a handsome tree, but the percentage of trees of good form in plantations is relatively smaller than the other named kinds. Planting stock is difficult to obtain, and is expensive.

Pines.—In sections of Ohio where pine is native to old fields, it is used to some extent for Christmas trees. It is probable that there would be a limited demand for planted stock. The white, red, Scotch, and Ponderosa pines would be best for such use.

ADAPTABLE SOILS AND SITES

The spruces, firs, and pines in general will grow on any Ohio soils that are not wet or swampy. For that reason it is safest to select hillsides where the soils are usually well drained. Idle land of this character is suitable, but all brush must be removed before planting. Level land has the advantage in that the plantations can be cultivated without danger of soil erosion.

Freestone soils are better for the growth of the spruces and firs than those of limestone formation, but these species will grow to Christmas tree size on limestone soils.

Avoid the flood plains of streams or locations which overflow or become inundated. The trees are almost certain to be ruined. Bear in mind that well drained sites are always best, no matter how stony the land may be.

Northerly or easterly exposures are best, but the trees will grow well on the other exposures, especially in the latitude north of Columbus.

Planting stock.—The planter has the choice of two methods of starting a Christmas tree plantation. He may purchase two-year

seedlings and line them out in nursery rows for two years, after which they can be planted on the permanent site, or he can purchase four-year transplants for planting directly on the site. Two-year seedlings of spruce are from 4 to 10 inches in height, depending on where they have been grown. They cost from $5 to $8 per thousand. Four-year transplants are from 8 to 18 inches high, and cost from $20 to $40 per thousand.

The advantage in the use of 2-year seedlings is the less initial cost of the stock, and the fact that after two years in the planters own nursery they can be removed freshly dug to the permanent planting site nearby. Advantages of the four year stock are that it obviates the use of the nursery, and gives the planter larger stock and earlier returns. Transportation charges are of course higher on the larger trees, and there is some danger of their drying out in transit, with subsequent losses.

The nursery.—If the planter elects to purchase two-year seedlings he should line them out in nursery rows. The nursery site may be located on any well drained fertile soil. The garden is ordinarily well adapted for such purpose. The nursery rows should be about 14 inches apart, and trees 4 or 6 inches apart in the row.

Lay the rows off with a twine line, so they will be straight. Then with a spade draw the line on the earth. Remove the twine and make a continuous cleft by inserting the spade in the ground 5 or 6 inches, and working it back and forth. After the trench is opened, insert the roots of the seedlings in the ground about one inch deeper than they stood in the seed beds. Draw enough earth into the trench with the hands or feet to hold the seedlings in place. After the row is completed in this manner, insert the spade into the ground, about 5 inches to one side of the row in continuous cleft, and push the earth firmly against the roots. Close this trench with a garden rake, then walk down the row with the feet near the line of trees and tramp them in firmly. It is important that the trees be planted firmly, otherwise there will be losses. More evergreen seedlings die because of lack of proper firming in the ground than from any other cause. After they are planted, a good test is to go down the row, grasp a tree now and then by the top and determine whether it can be easily lifted. If it lifts easily it will probably die. Cultivate or hoe often enough during the growing season to keep weeds down. A hand wheel cultivator is a good implement for tending the trees. Do not make the nursery rows wide enough apart to cultivate with a horse cultivator. This is unnecessary, and not advisable from any aspect.

The seedlings should be left in the nursery rows not less than two years. Ordinarily they are large enough at that time to transplant on the permanent site. Under no circumstances should the trees remain in the nursery more than three years.

Winter care of trees in nursery.—Summer cultivation should cease by August 1. The advent of the fall grasses following cessation of cultivation will not harm the trees, but rather will tend to benefit them during the winter. The only attention the planter needs to give his trees in the winter is to see that they are not heaved out of the ground by alternate freezing and thawing. The effect of heaving on some soils is more disastrous than on others. Most clay and silt loam soils will heave. The seedlings can be protected by mulching them with straw or leaves. This mulch should be applied three or four inches thick after the ground first freezes in early winter or late fall. Place the mulch material between the rows and close to the trees. Do not cover the trees any more than necessary. The purpose of the mulch is to keep the ground from alternate freezing and thawing. Remove the mulch after the weather becomes settled in early spring, but before growth starts, and resume cultivation thereafter as soon as the soil dries out. It is best to mulch the trees also the second winter. They will come thru in better condition for permanent planting.

THE PLANTING SITE

Preparation.—The trees will grow faster and a better stand can usually be obtained if the land is plowed, and cultivation carried on for two or three years thereafter. Cultivation, however, is not necessary to insure successful establishment of the plantation, and on steep hillsides would not be desirable because of soil erosion. Cultivation is particularly desirable in heavy blue grass or timothy sod, where it would be difficult for the young trees to get a start. Such sites should always be first plowed and prepared before planting. Cultivation of the trees should not be continued for more than two or three seasons.

If the site contains brush, it of course should be cut off before planting.

Spacing trees in plantation.—The proper spacing of trees is from 3½ to 4 feet each way, requiring respectively 3,550 and 2,720 trees per acre. Either distance will give sufficient space for the trees to develop to a marketable size before thinning is necessary.

Planting the trees.—Rows can be laid out with a marker so that they will be straight in each direction if desired. On hillsides and irregular ground, it is oftentimes impossible to lay off straight rows. In any case the trees will grow as well either way.

Planting is facilitated where the ground has been plowed and harrowed. One man should have no difficulty in setting 1,000 trees a day. If the ground is mellow, a cleft can be made with a spade, the roots inserted, loose dirt kicked into the cleft with the foot, and the soil tramped firmly about the trees with the feet. It is very important that the trees be firmly planted, otherwise there is sure to be losses. The planter should circle about the tree with the full weight of his body on his feet. Keep the trees cultivated after they are planted, but let the fall grasses come in. They will tend to prevent heaving the first winter. After two seasons of cultivation the trees will take care of themselves until ready to harvest.

Where the ground is not plowed, it is necessary to dig holes for the trees, and planting in consequence will be slower. Dig holes large enough to take the roots without crowding. Keep large clods of earth and pieces of sod from direct contact with the roots. Use the finer soil first and pull the sods around the trees after the hole is filled. Then *firm the trees well* with the feet. A mattock or a spade is the best tool for planting where the ground is not plowed.

PROTECTION

Do not permit hardwood trees or brush to grow up in the plantation. They will injure the form of the evergreens.

Exclude livestock of all kinds from the plantation. Pasture and Christmas trees are a poor combination.

Keep fire away from the trees. The entire plantation may burn over in a few minutes during a period of drouth and destroy all of the trees.

MARKETING

On most soils spruce will attain sufficient growth so that some of the most vigorous trees can be marketed in four or five years after planting four-year old stock in permanent plantation. The entire plantation can be cut within ten years. At the end of this period many of the trees will be over ten feet in height. The greatest demand for trees is in heights ranging from five to eight feet. Larger sizes are used, and of course command higher prices.

Christmas trees may be sold locally to home owners or local distributors, or they may be shipped to the wholesalers in the larger cities.

COSTS AND PROFITS

Anyone who contemplates growing Christmas trees is of course seeking information relative to the cost of the operations and the profits to be realized from the venture. Both will vary in each individual case, and are dependent upon a number of factors, including the manner in which the land is prepared for planting, the efficiency with which the trees are set, subsequent amount of cultivation and care, the rate of pay for labor, the location from markets, the efficiency with which the trees are cut and transported to market or shipping point, and the ability to find the best and most profitable market. If the ground is plowed and prepared and 4-year transplants are purchased or grown at a cost of $25 per thousand, and 3,550 trees are planted per acre, the total cost on the average should be about $115 per acre, excluding taxes, interest on investment, and land rental. This includes all labor charges. It is obviously difficult to predict the price that future Christmas tree stock will bring. The fact that evergreen trees and greenery at the holiday season is increasing in use each year, and that the Christmas tree has been an institution for years in this country would indicate that if there are no large surpluses of stock, future prices will be satisfactory.

Fig. 3.—Christmas tree plantation of Norway spruce 5 years after planting

If 2,500 to 3,000 trees per acre can be brought to marketable size and disposed of at only 30 cents a piece, in wholesale lots over a period of ten years, the gross income of $750 to $900 per acre would leave a sufficiently attractive margin of profit over the cost of production.

Plantations close to the larger cities can be disposed of at less cost and possibly higher prices with better opportunities for selling to a retail trade.

TRENDS IN SALES AND PRICES OF OHIO FARM PRODUCTS SINCE 1910

V. R. WERTZ

The farmer's gross cash income depends upon two variables—the quantity of goods which he sells, and the prices which these goods command. Information has been available concerning prices and production of the several commodities on Ohio farms, but no attempt has previously been made to put into one quantitative statement the trend in quantity of all farm products sold from Ohio farms. The figures in the following table give the trend in gross cash income from Ohio agriculture since 1910 together with estimates of the quantity of products sold and their prices.

TABLE 1.—Ohio Farm Products: Indices of Sales, Prices, and Income, 1910 to 1928

(Base=1910—1914)

	Series A sales		Series B price		Series C income		Series A sale		Series B price		Series C income
	Based on quantity of goods sold		Based on Ohio farm price		Based on gross cash income		Based on quantity of goods sold		Based on Ohio farm price		Based on gross cash income
1910	101.3	x	102.5	=	103.8	1920	119.2	x	205.0	=	244.4
1911	101.7	x	89.7	=	91.2	1921	106.2	x	130.9	=	139.0
1912	93.8	x	101.9	=	95.6	1922	113.0	x	122.5	=	138.4
1913	97.7	x	103.6	=	101.2	1923	113.5	x	135.3	=	153.6
1914	102.1	x	105.9	=	108.1	1924	115.2	x	133.5	=	153.8
Av. 1910-1914	99.3		100.7		100	Av. 1920-1924	113.4		145.4		165.8
1915	109.1	x	102.5	=	111.8	1925	105.6	x	156.5	=	165.3
1916	104.8	x	117.8	=	123.5	1926	119.0	x	147.6	=	175.6
1917	105.6	x	186.8	=	197.3	1927	114.0	x	144.5	=	164.7
1918	122.3	x	202.2	=	247.3	1928	99.7	x	150.7	=	150.2
1919	134.2	x	204.0	=	273.8						
Av. 1915-1919	115.2		162.7		190.7	Av. 1925-1928	109.6		149.8		164.0

Three index series are given here: Series A, representing the quantity of Ohio farm products sold annually; Series B, representing the level of Ohio farm prices annually; and Series C, an index of gross cash income from Ohio agriculture.

The formula used in arriving at series A and B is the Fisher "ideal" formula:

$$P = \sqrt{\frac{P_1 Q_0}{P_0 Q_0} \times \frac{P_1 Q_1}{P_0 Q_1}} \qquad Q = \sqrt{\frac{Q_1 P_0}{Q_0 P_0} \times \frac{Q_1 P_1}{Q_0 P_1}}$$

The base used in these calculations was the pre-war period 1910-1914. The outstanding advantage of this method of calculating series A and B is that it gives two series which will meet the factor-reversal test, i. e., Series A and B when multiplied together gave C, the gross cash income series.

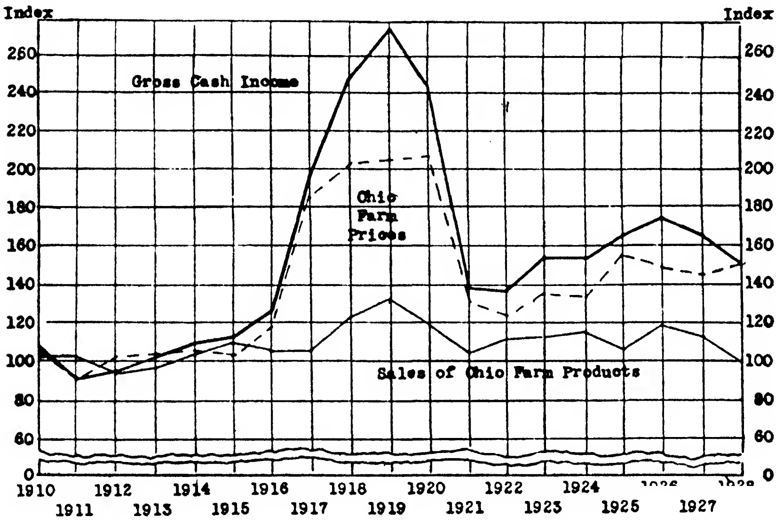

Fig. 1.—Ohio farm products: trends in quantity of farm products sold, farm prices, and gross cash income, 1910 to 1928

Both quantity of Ohio farm products sold and prices of these products have increased since the pre-war period 1910-1914. The price level of Ohio farm products averaged 62 percent above its pre-war level for the five years 1915 to 1919, 44 percent above from 1920 to 1924, and 49 percent above pre-war from 1925-1928. This general increase in farm prices was due largely to the increase in the general price level. The quantity of farm products sold from Ohio farms increased from 100 in the period 1910 to 1914 to 116 from 1915 to 1919, fell to an average of 114 from 1920 to 1924, and stood at 110 for the last four-year period. The decrease in quantity of sales in 1928 was due very largely to a poor corn crop in 1927 and a short wheat crop in 1928.

Poultry and dairy products have made the most favorable showing of any Ohio farm products with respect to quantity of goods sold. For the four years ending in 1928 the estimated quantity of poultry and eggs sold from Ohio farms was 48 percent higher than in the base period 1910-1914, while the quantity of dairy products sold stood 46 percent higher than from 1910-1914. The product making the least favorable showing with respect to quantity sold was tobacco. For the last four years, 1925-1928, the quantity of Ohio tobacco sold averaged 55 percent below that in the base period, 1910-1914.

It is significant that this increased quantity of products sold from Ohio farms came about coincident with a smaller amount of land in farms and fewer people engaged in Ohio agriculture.

RATIO OF POULTRY FEED TO THE PRICE OF EGGS AND POULTRY

J. H. SITTERLEY

Profits in poultry bear a close relation to the ratio between feed costs and poultry and egg prices. Of the total cost of producing poultry and eggs on Ohio farms, from 50 to 60 percent is feed costs. The price of feed varies from month to month and year to year, while the other important items of cost, labor, and overhead remain fairly constant. Profit in the poultry industry depends on the margin between cost of production and the amount received for the products. The price received for eggs and poultry may be low, yet if feed prices are correspondingly low the margin of profit may be as great or even greater than in a period of high feed and poultry prices. In years when feeds are scarce and poultry products are low, the amount of feed that a given amount of poultry products will buy will be small. In years when the opposite is true the ratio of feed prices to the price of poultry and eggs will be high.

In the accompanying table and chart the cost of 100 pounds of poultry ration[1] is compared for each year since 1920 to the value of 6 dozen eggs and 4.3 pounds of poultry, which is assumed as a fair division of income from poultry products.

[1]Poultry ration used was 45 pounds of corn, 35 pounds of wheat, 10 pounds of oats, and 10 pounds of meat scrap.

TABLE 1.—Yearly Average Price of Eggs, Poultry, and Poultry Ration

Year	Eggs per doz.	Poultry per lb.	Poultry ration per cwt.	Value of 6 doz. eggs plus 4.3 lb. of poultry	Equivalent in feed of 6 doz. eggs and 4.3 lb. of poultry
	Ct.	*Ct.*	*Dol.*	*Dol.*	*Lb.*
1920	51.0	27.2	3.26	4.23	130
1921	35.5	22.1	1.69	3.08	183
1922	30.8	20.4	1.66	2.72	164
1923	31.2	20.4	1.82	2.75	151
1924	33.0	20.6	1.93	2.87	149
1925	36.3	22.0	2.28	3.12	137
1926	33.4	22.8	1.88	2.98	159
1927	30.1	21.4	1.91	2.72	142
1928	32.7	22.7	2.18	2.95	139
1929	34.7	24.2	1.91	3.14	164

The ratio of poultry feed to the price of eggs and poultry would indicate that 1929 was the most profitable year for the Ohio poultry producer since 1922. Feed prices for 1929 were average or slightly below average while the price of both eggs and poultry were above average. The price for eggs and poultry during 1929 was accompanied by an increase in the number of chicks raised, which was reflected somewhat in a lower price for live poultry during the last few months of the year.

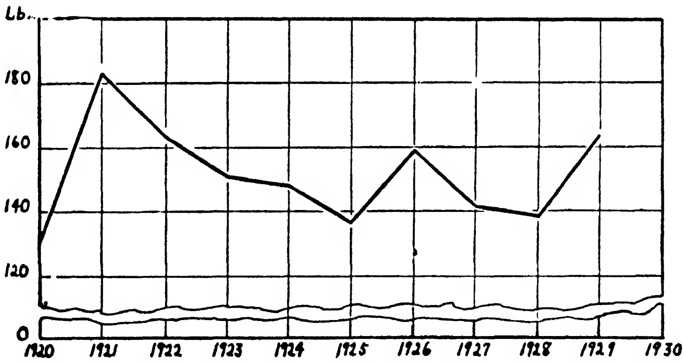

Fig. 1.—The amount of poultry ration equivalent in value to 6 dozen eggs and 4.3 pounds of poultry, at Ohio farm prices of grain, eggs, and poultry and Cleveland price of meat scraps.

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

The index of Ohio cash income from sales has been revised. The new index is published in this issue and will be carried in the future. The index of sales is made up by multiplying the quantity sold by the price per unit. Accompanying this index of sales there should be an index of expenses. While the volume of sales has increased since the pre-war period the volume of expenses has also increased. For instance, the partial substitution of the automobile, truck, and tractor for the horse on the farm has resulted in a larger percentage of the products being sold. At the same time it has caused an increase in the volume of expenses, since machines, gasoline, and repairs must now be purchased. An index of expenses will soon be ready to include on this page.

While the income for the year 1929 was higher than that for 1928, the months of November and December showed material decline in income, the income during these months being less than in 1928.

Trend of Prices and Wages, 1910-1914=100

	Wholesale prices all commodities U. S.	Weekly earnings N. Y. State factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm products prices	Ohio cash income from sales
1913	102	......	100	100	104	100	105	101
1914	100	100	101	102	102	102	105	107
1915	103	101	106	100	103	107	106	110
1916	130	114	123	117	113	113	121	121
1917	181	129	150	176	140	119	182	198
1918	198	160	178	100	175	131	203	243
1919	210	185	205	209	204	135	218	266
1920	230	222	206	205	236	149	212	245
1921	150	103	156	116	164	134	132	136
1922	152	297	152	125	145	124	127	136
1923	156	214	153	135	166	122	134	149
1924	152	218	154	134	165	118	133	150
1925	161	223	159	146	165	110	159	164
1926	154	229	156	136	170	105	155	176
1927	149	231	154	131	173	99	147	163
1928	153	232	156	139	169	96	154	147
1929	151	......	......	......	......	......	151	154
1929								
January	152	234	156	133	166	......	144	145
February	151	236	156	136	......	......	149	177
March	153	239	156	140	......	94	155	144
April	152	237	155	138	163	......	150	148
May	150	236	155	136	......	......	152	149
June	151	236	154	135	......	......	153	156
July	154	235	154	140	172	......	157	174
August	153	237	154	143	......	......	159	163
September	153	240	154	141	......	......	153	166
October	151	237	154	140	174	......	151	166
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The Bimonthly Bulletin

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Ohio Agricultural Experiment Station

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WOOSTER, OHIO, U. S. A.

Free Bulletin

C. G. Williams

Director

W. K. Greenbank, 1869-1930

Mr. W. K. Greenbank came to the Ohio Agricultural Experiment Station eighteen years ago from the superintendency of the public schools of Clinton, Ohio. Without special agricultural training, he had long been greatly interested in agriculture and was a frequent visitor to the Station while engaged in public school work.

He first served this Station as clerk to the Director, guide to visitors, and librarian. Eight years ago he was made editor of the Station's publications, in which capacity he served until his death, March 17, 1930.

The efficiency of Mr. Greenbank's work as editor is attested by the fact that during his term of service two of the Station's bulletins were awarded first place in a nation-wide competition conducted by The American Association of Agricultural College Editors.

His careful, thoro work will long be remembered by the large staff of Station workers whom he served.

SPRAY INJURY AND FRUIT SET

F. S. HOWLETT AND CURTIS MAY

It has been suggested from time to time that lime-sulfur sprays reduce the set of fruit. Orchardists know that strong lime-sulfur solutions sprayed on young apple foliage and fruits may cause severe injury. But there has been little evidence to show the extent of the loss when there is no visible spray injury to the foliage of shoots and fruit spurs.

Experiments were carried out in 1927 and 1928 at Wooster to determine whether dropping occurred when the foliage of shoots and spurs was not visibly injured. For these tests Ensee and Grimes Golden, two varieties very susceptible to spray injury, were used. Several dilutions of lime-sulfur were applied two to three weeks after bloom, the time when it is commonly thought that abnormal fruit dropping may be brought about.

In 1927, the fruit clusters were sprayed individually by means of a hand barrel pump; in 1928, a regular orchard sprayer (375 pounds pressure) was used. Part of the clusters on each tree were covered with glassine bags; the remaining exposed clusters were then sprayed with one dilution of lime-sulfur. These clusters were then covered and a second set exposed and sprayed with another dilution of lime-sulfur solution. Unsprayed checks were left on each tree. The results were taken after the June drop was completed.

The results of the tests in 1927 are given in Table 1. The percentage set of all sprayed clusters of both trees was lower than that of the unsprayed clusters. Statistical methods showed that the differences were due to the spray treatments.

The results for Ensee in 1928 indicated that the 1 to 60 and the 1 to 100 dilutions caused slight fruit dropping.

On Grimes Golden tree 409-4 there was a marked reduction from the clusters sprayed with 1 to 60, but none from those sprayed with 1 to 100 lime-sulfur. On tree 409-5 the reduction in set caused by 1 to 60 and 1 to 120 dilutions apparently did not cause greater dropping than occurs on the unsprayed clusters.

By the use of statistical methods it was apparent that 1 to 60 lime-sulfur reduced and that 1 to 100 or greater did not reduce the set of fruit on these trees. Since the former caused fruit dropping

and the latter did not, it may be concluded that the dilution at which there would cease to be significant injury would be between these two.

On none of the days on which sprays were applied was the temperature high enough to cause visible fruit or foliage injury when the standard strength of lime-sulfur was used. It is generally regarded that 80° F. (26.5° C.) is the danger point for lime-sulfur spray burn. In 1927 it was five days, and in 1928, two weeks after the spray was applied, before this temperature was recorded.

In general, the weather during the periods following the spraying in both years was cool, and cool weather is supposedly not conducive to lime-sulfur injury.

TABLE 1.—The Effect Upon Fruit Abscission of Spraying Young Ensee Apples With Lime-sulfur, Wooster

Tree	Dilution of spray	No. of clusters	Percentage set of fruits	Percentage of clusters with		
				No fruits	1 fruit	2 fruits
			1927			
411-3 Ensee	1-15	93	51.6	22.6	51.6	25.8
	1-40	96	60.4	16.7	45.8	37.5
	1-60	89	60.7	16.8	43.8	39.4
	Unsprayed	102	84.8	4.9	20.6	74.5
411-2 Ensee	1-15	82	61.0	17.1	43.9	39.0
	1-40	94	68.1	10.6	42.6	46.8
	1-60	100	67.0	16.0	34.0	50.0
	Unsprayed	99	93.4	0.0	13.1	86.9
			1928			
411-1 Ensee	1- 60	222	73.4	5.9	41.4	52.7
	1-100	223	76.9	5.4	35.4	59.2
	Unsprayed	215	83.3	3.6	26.1	70.3
409-4 Grimes	1- 60	174	31.9	48.8	38.5	12.6
	1-100	187	51.3	20.9	55.6	23.5
	Unsprayed	216	48.1	27.8	48.1	24.1
409-5 Grimes	1- 60	172	59.4	17.1	46.8	36.1
	1-120	169	63.7	12.8	47.1	40.1
	Unsprayed	195	69.0	10.3	41.5	48.2

The loss of fruit due to the lime-sulfur sprays, applied at the 2-3 weeks' period, was not great enough to indicate that such sprays would cause a reduction in the commercial crop. This is true provided (1) the foliage is not visibly injured, and (2) the varieties concerned do not have an abnormally heavy first drop. In connection with this second point it is well to understand the fruit setting characteristics of these varieties. Immediately after petal fall on Ensee and Grimes Golden, 3 to 5 flowers in a cluster usually enlarge and survive the first wave of dropping. The enlargement

is marked about a week before the two-weeks' spray. However, this heavy set is usually reduced considerably in the late, or June, drop. Trees of these varieties which are adequately pruned and fertilized usually require heavy thinning. Therefore, it seems certain that even with varieties susceptible to spray injury the slight dropping due to lime-sulfur sprays applied at the 2-3 weeks' period would not reduce a commercial crop provided the foliage were not visibly injured.

Altho no work was done on other varieties, it is very likely that no more and probably less dropping would be caused on other heavy-setting varieties, as Baldwin, Oldenburg, Yellow Transparent, Northern Spy, Wealthy, Winter Banana, Jonathan, and Rome Beauty, which are not generally considered so markedly susceptible to spray injury.

TABLE 2.—Relation of the Time of After-bloom Sprays to End of Fruit Abscission, Wooster, 1924-1928

Year	Dates of application		Date of June drop
	Petal fall spray	Two-weeks' spray	
1924	May 22—29	June 9—13	June 6 - July 7
1925	May 8 - 16	May 26—June 4	June 4—July 1
1926	May 26—31	June 10—17	June 10—July 7
1927	May 12—17	May 31—June 2	June 2—July 1
1928	May 25—29	June 8—13	June 9—July 1
1929	May 6- 17	May 23—June 3	June 1—July 1

The writers are not in position to offer evidence as to whether lime-sulfur sprays would cause greater reduction on Stayman Winesap, Winesap, Arkansas (Black Twig), and Delicious than on Ensee and Grimes Golden. Normally these varieties have a very heavy drop shortly after bloom (a drop much greater than that of Grimes Golden), but the late wave is usually considerably less. Two points may be made in this connection in view of our present knowledge of the fruit setting characteristics of these varieties: first, sprays resulting in visible injury to the leaves will likely reduce the commercial crop of Stayman Winesap and Delicious considerably more than that of the heavy setting varieties, such as Grimes Golden and Jonathan; second, these varieties produce full commercial crops in many orchards where lime-sulfur sprays are a part of the regular orchard practice.

It is well to remember that mere observation of fruit falling shortly after the application of a spray is not necessarily evidence that such dropping is due to the spray. It has generally been

stated by those who have maintained that lime-sulfur removes fruits, that such falling occurs after the second after-bloom spray. This, the writers believe, is due to the fact that the spray is applied usually, if not always, just previous to or during the June drop. The dates of the period of the June drop and of the second after-bloom sprays at Wooster from 1924 to 1929 are given in Table 2. It is to be observed that each year normal dropping occurred for two to three weeks after the application of this spray.

The writers have not carried on work to determine whether lime-sulfur sprays applied at any other time will decrease the set of fruit, even if no foliage is visibly injured. Undoubtedly burning of the foliage in the pre-blossom and calyx sprays will have a marked effect upon fruit dropping.

The loss of fruit due to the use of lime-sulfur in the 2-3 weeks' spray is not as important as other factors affecting fruit setting. The trees should be kept in good commercial vigor by adequate pruning and fertilization, and soil culture and cross-pollination should be provided for.

SUBSTITUTES FOR GLASS ON HOTBEDS AND COLDFRAMES

DONALD COMIN AND WALTER SHERMAN

INTRODUCTION

Paraffin and celluloid as substitutes for glass in hotbed and coldframe sash have been on the market for some time. Many unwarranted claims concerning their effect on plant growth are made for these substitutes. Among these are rash statements concerning their durability, strength, general resistance to weather conditions, and economy.

Tests were conducted at Wooster in 1928, and at Mahoning County Farm in 1929 to determine the usefulness of several glass substitutes for hotbed and coldframe sash covering. Ten vegetable crops, representing the various types, were grown during the seedling stage under sash covered with glass substitute materials and under glass as the control. Six manufacturers supplied their particular product for these tests.

DESCRIPTION OF GLASS SUBSTITUTES

The glass substitutes used in this test fall into two classes: (1) loosely woven cloth which is impregnated with paraffin (Flex-O-Glass, Glass Fabric, and Glass Cloth); (2) a film, of variable thickness, of celluloid on a wire mesh (Cell-O-Glass and Screen Glass). Both the cotton fiber (cellulose) and the paraffin of the first class are transparent to the ultra-violet rays from the sun. The celluloid of the second class may be either a nitrate or acetate of cellulose.

QUANTITY OF LIGHT TRANSMITTED

Both classes of materials are translucent (or semitranslucent) and consequently scatter the light which they receive. The base of these substitutes is a mesh, the interstices of which allow the transmittance of the greater part of the light.

Table 1 compares the characteristics of two of the substitutes tested; the remaining materials in each class are assumed to compare very closely with the tested substitutes, for in some cases they are manufactured under the same patent.

TABLE 1.—Light Transmission of Glass and Glass Substitutes*

Material	Total light transmitted	Light reflected by mesh base	Total light reflected or absorbed	Transmission of ultra-violet excluded by glass
	Pct.	*Pct.*	*Pct.*	*Pct.*
Glass	95–100	....	0– 5	....
Cel-O-Glass	45– 60	35–35	40–50	25–30
Flex-O-Glass	25– 35	....	60–70	1– 5

*Spectral Characteristics of Light Sources and Window Materials used in Therapy. Reprint from the Transactions of the Illuminating Engineering Society, Vol. 23, No. 3, March, 1928.

The wire mesh of Cel-O-Glass obstructs from 33 to 35 per cent of the incident light. Thus, the maximum amount that can be transmitted thru this material is approximately 60 per cent of the incident solar radiation. When absorption and internal reflection of the celluloid film are taken into account this may be reduced to 45 or 48 per cent, depending upon the thickness of the film. As the material becomes discolored and less homogeneous by weathering, the transmission is still further decreased.

In the case of Flex-O-Glass, altho the cloth base transmits a portion of the incident light, there is sufficient absorption and internal reflection from the cloth and paraffin to maintain a rather low total transmission. The loss by reflection from the outer

surface is high, 60 per cent or more. As a result, the total amount of solar radiation transmitted to the interior of the hotbed is low. About 25 to 35 per cent of the incident light is diffusely transmitted. Ordinary glass which is commonly used for hotbed sash transmits approximately 95 per cent of the incident light.

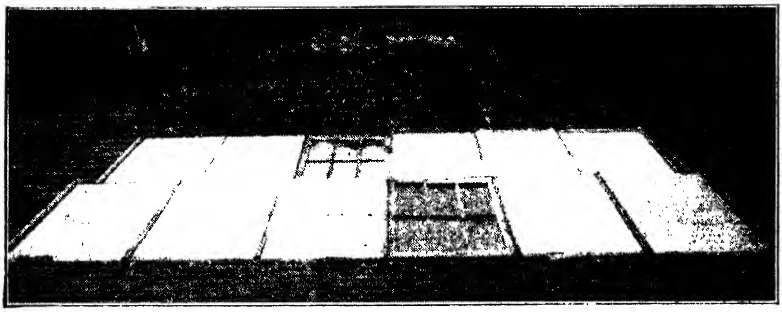

Fig. 1.—Duplicate series of five glass substitutes compared with glass at Wooster

Shirley, reporting his results with Bonny Best tomato, in the American Journal of Botany, 1929, states that in general the light intensity cannot be reduced much below 50 per cent of full sunlight without causing a decrease in the growth of many plants. In the case of the tomato the light intensity may be reduced to 50 per cent of normal daylight in midsummer without seriously affecting the growth of this plant, but a further reduction of 20 per cent caused decreased growth. Also, he found that low light intensity favors top growth at the expense of root growth. It was also evident that plants under high light intensities tend to attain complete height growth earlier than shaded plants due to the fact that they mature earlier. Thus, the total transmission of incident light of the glass substitutes tested was close to the minimum as found by Shirley.

QUALITY OF LIGHT TRANSMITTED

Table 1 gives the percentage transmission of light of various wavelengths, which is equivalent to "quality". The short wavelength light is termed "ultra-violet" and is commonly supposed to produce effects similar to those of vitamin D. These ultra-violet rays are excluded by common window glass.

Flex-O-Glass, the cloth-base substitute used in this test, transmits from 1 to 5 per cent of the light shut out by window glass. Cel-O-Glass, the screen base material, transmits from 25 to 30 per cent of the ultra-violet, which is excluded by glass.

The evidence so far obtained indicates that the light rays (ultra-violet) excluded by common window glass but transmitted by the glass substitutes are not beneficial to plants. Several studies have been made at the Boyce Thompson Institute upon plants grown under various "qualities" of light, which show that there is no marked difference in the form, weight, time or amount of flowering, or yield of the plants, whether they receive the extreme ultra-violet of the sunlight or that portion which passes thru glass. Thus the intimated value of glass substitutes in transmitting light which is excluded by common window glass is doubtful if not wholly improbable. The fact that perfectly healthy and sturdy seedlings are grown in greenhouses under glass substantiates this point.

HEAT TRANSMITTED

The increase in temperature within the bed covered with glass or glass substitutes is directly due to the "heat" or long wavelength rays from the sun. Indirectly, the accumulation of heat is due to the trapping of these rays after they have been reflected from the surfaces within the bed, and the low conduction of heat thru the sash coverings. It is almost impossible to measure each of these factors singly; however, their total effect was measured by placing one thermocouple of a dual recording thermograph within an insulated box covered with glass, and the other in a similar box covered with a glass substitute, repeating the measurements for each substitute in comparison with glass over a sufficient period of sunshine, cloudiness, and variation in outside temperatures.

The results, tho not complete at this writing, indicate that glass transmits considerably more of the "heat" rays than do the screen base materials, and, in turn, these materials transmit more of these long rays than do the paraffin materials. This is evident by the rapid rise in temperature under the glass in comparison with the substitutes.

On the other hand, during the period of no sun and relatively low outside temperatures the heat within the box covered with glass is lost more rapidly than under the screen base substitutes, indicating that these materials have greater insulation value than glass. This would be an important factor in the early portion of the growing period when the nights were relatively cold, for this would minimize the danger from frost injury and reduce the necessity for applying artificial heat within the bed during this period.

EXPERIMENTAL RESULTS

Soil and air temperatures.—The soil and air temperatures taken thruout the day in hotbeds covered with glass and glass substitutes are given in Table 2.

At the Mahoning County Farm the variation in temperature of either the soil or air was slight. The Screen Glass maintained temperatures two to three degrees higher than glass. This difference in favor of the substitutes is hardly significant. The records indicate that the rise in temperature is slightly more rapid beneath glass, altho the substitute, Screen Glass, produced a higher total temperature.

TABLE 2.—Air and Soil Temperatures in Hotbed Covered With Glass and Glass Substitutes

Mahoning County Farm

Average temperature readings April 1 to May 23	Outside air temperatures	Air temperatures under hotbed sash		Soil temperatures under hotbed sash	
		Glass	Screen Glass	Glass	Screen Glass
	°F.	°F.	°F.	°F.	°F.
7:00 A. M.	44	....	....	53	52
9:30 A. M.	56	....	....	60	62
12:00 noon	62	....	....	67	69
3:30 P. M.	59	....	....	66	67
7:00 P. M.	52	....	....	62	61
Maximum	63	81	82	68	72
Minimum	43	45	47	53	52
Mean	53	63	64	60	62

Soil temperatures under hotbed sash
Wooster

March 25 to May 5	Glass	Cel-O-Glass	Screen Glass	Flex-O-Glass	Glass Cloth	Glass Fabric	Av. of screen-base materials	Av. of cloth-base materials
8:00 A. M.	51	50	51	51	50	52	50.5	51.0
12:00 noon	77	72	77	72	70	73	74.5	71.7
5:00 P. M.	70	69	72	67	66	68	70.5	67.0
Av. air temperatures under hotbed sash	73	66	....	69	67	71	66.0	69.0

At Wooster the same general similarity between the temperatures occurred. Glass consistently maintained a slightly higher temperature in the hotbed than did the screen-base materials, which, in turn, maintained higher temperatures than the cloth-base materials. In no case was the temperature difference great enough to be considered significant.

Effect on germination and growth.—At the Mahoning County Farm the vegetables, cabbage, tomatoes, peppers, and lettuce, were seeded in hotbeds covered with glass and Screen Glass.

The cabbage and tomato seedlings emerged thru the soil at the same time under both materials. The pepper and lettuce seedlings made their first appearance under the glass sash. Germination counts are given in Table 3. The glass had the most favorable effect on pepper and lettuce while the Screen Glass allowed a larger germination with cabbage and tomatoes.

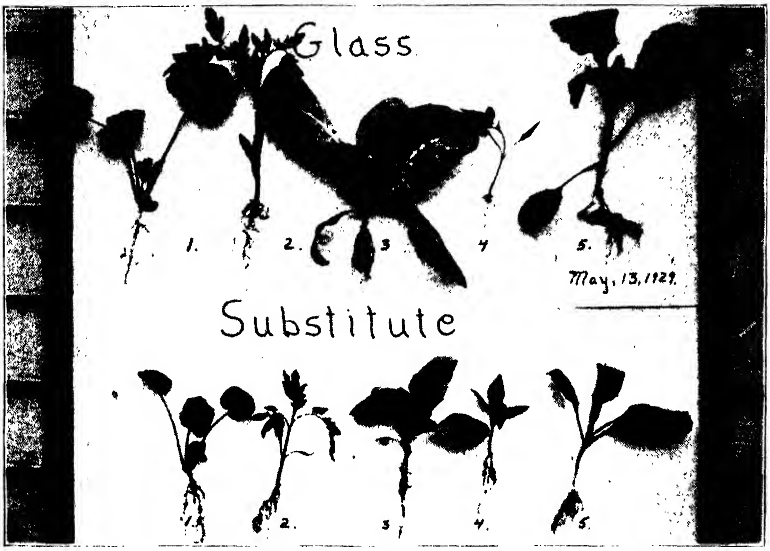

Fig. 2.—Seedlings grown under glass and Screen Glass ready for field setting

The seedlings were transplanted once while in the hotbed. Observations made during the time the plants were under the hotbed sash indicated that the growth under the glass was superior to that under the Screen Glass. This was apparent by the darker color of the foliage, their greater vigor of growth as they grew older, and a greater height in all cases under glass. The tendency for the leaves to curl inward and turn white was characteristic of all seedlings beneath the glass substitute. That the seedlings were distinctly better and more vigorous under glass was attested by the fact that on June 11 eleven tomato plants had blossoms under glass while only two were blossoming under Screen Glass. Lettuce was particularly affected by a severe curling and tip-burning of its leaves beneath the substitute.

The full-grown seedlings were set in the field and yield records taken. No records were obtained on the lettuce due to a crop failure. No difference in color, height, or general appearance could

be noted after the plants had been in the field for some time. The stunting effect in the hotbed was particularly noticeable in the early yields of the cabbage and would probably have been reflected in like manner with the lettuce crop. The yield figures in Table 3 show this greater early yield for cabbage. The pepper plants yielded about the same regardless of their condition when set in the field. The tomato plants produced more fruits when grown under Screen Glass. There was considerable blossom-end rot prevalent in the tomatoes which precluded a fair comparison. The two leafy crops showed the greatest setback in the hotbed under Screen Glass. The stunted condition of plants grown under the substitutes was partially or totally overcome after the plants were set in the field. This recovery was slower in the case of the leafy crops than the fruiting crops.

TABLE 3.—Effect of Glass and Glass Substitutes on Vegetables

Mahoning County Farm

Crop	Germination count			Seedling height			Yield at harvest		
	Date	Glass	Screen Glass	Date	Glass	Screen Glass	Date	Glass	Screen Glass
					In.	*In.*		*Lb.*	*Lb.*
Cabbage	Apr. 7	220	270	May 13	6- 8	4- 6	Aug. 6	60	26
	19	212	275	30	12-14	7- 8	20	17	45
	23	206	266				Sept. 6	26	13
Total..	....	....	....	....	....	....	....	103	84
Tomatoes	Apr. 7	104	152	May 13	5- 6	3- 5	Aug. 20	3	3
	19	132	166	30	20-22	14-15	29	10	5
	23	126	162				Sept. 10	53	60
							Oct. 4	82	92
Total..	....	....	....	....	....	....	....	148	160
Peppers	Apr. 7	0	0	May 13	3- 5	1- 3	Sept. 6	24	24
	19	223	106	30	6- 7	6- 7	18	3	3
	23	262	149				Oct. 9	19	19
Total..	....	....	....	....	....	....	....	46	46
Lettuce	Apr. 7	247	228	May 13	3- 5	2- 3			
	19	254	251	30	7- 8	6- 7			
	23	252	250						

The recovery and subsequent effect on yield depend upon several factors; i. e., the type of vegetable growth, length of time the seedlings are subjected to hotbed conditions, and the conditions prevailing in the field after the plants have been set out.

At Wooster, ten vegetable crops representing the many types often found in hotbeds or cold frames were seeded under six commercial products used on hotbeds. These crops and the various glass substitutes are given in Table 4. The growth of the seedlings under glass was assumed to be 100 for purposes of comparison, with the weight of twenty plants grown to the correct stage for setting in the field as its basis.

With the exception of one crop, parsley, all vegetables made as much or more growth during the seedling stage when grown under glass. The majority of the vegetables made only from 40 to 90 per cent as much growth under the screen-base materials and from 40 to 70 per cent as much growth under cloth-base materials as under glass.

TABLE 4.—Weight of Plants Grown Under Glass Substitutes. Weight Based on 100 for Plants Grown Under Glass, Wooster

Crop	Cel-O-Glass	Glass Cloth	Flex-O-Glass	Glass Fabric	Screen Glass	Average celluloid materials	Average paraffined materials
Tomato	89	58	60	57	90	89	59
Pepper	102	71	82	78	91	97	77
Egg plant	47	34	71	53	39	43	53
Cucumbers	83	26	71	54	80	82	50
Cabbage	58	50	48	61	69	64	53
Cauliflower	71	32	64	42	72	72	46
Beet	100	33	57	73	....	100	54
Celery	86	78	55	72	....	86	68
Lettuce	71	68	52	68	76	74	63
Parsley	110	121	84	126	108	109	110

The same general stunting of growth, as well as a poorer appearance as to color and general vigor, was noticed for those seedlings under the substitutes at Wooster as at Mahoning County.

There was considerable variation between crops in their growth response as can be seen upon inspection of Table 4. Undoubtedly, all crops require a certain minimum of light for growth, but it would be hard to produce the optimum conditions for all vegetable plants grown under one hotbed covering.

DURABILITY AND COST

Glass does not deteriorate with age or usage to any appreciable extent. The screen-base materials (Cel-O-Glass, etc.) deteriorate somewhat, a general reduction in transmission of the ultra-violet rays taking place under weathering. The reduction was as much as 15 to 20 per cent in one case of an eight month's exposure. The cloth-base materials deteriorate the faster; this greatly reduces the light transmission and period of usefulness. The hot noon-day sun partially softens the paraffin; this allows dust and dirt to stick to the material, weakens its structure, rots the cloth base thru water penetration, and allows the material to shrink badly.

Breakage as contrasted to deterioration is greatest in glass, followed by the cloth-base and screen-base materials respectively. Glass is very fragile and may break during hail storms; the celluloid materials withstand severe blows; the paraffin materials are very

weak and easily punctured. The manufacturers suggest a method of patching the substitutes by melting the paraffin or celluloid impregnating substances with a hot iron and sealing in a new piece, which considerably prolongs their life.

These factors affect the life of these materials and thus their economy. Glass will last indefinitely if handled carefully and sections of glass sash may be replaced at a nominal cost. Good screen-base materials if handled carefully and stored in a dry place in a vertical position will last for some time, 2 to 5 years. The cellulose nitrate was found to be less durable than the acetate. The cloth-base materials are very inferior in this respect and seldom last over two years, with a practical life of one year on hotbeds.

The cost of the screen-base materials is high, approximately $1.20 per square yard, as compared with glass at $0.50 per square yard, and the cloth-base materials at $0.30 per square yard.

SUMMARY AND CONCLUSIONS

Glass, as a hotbed sash material, was superior to its substitutes for the raising of most vegetable plants, parsley being an exception. The stunting effect of the substitutes was overcome after the plants were set in the field in the case of tomatoes and peppers. Cabbage produced greater early, as well as total, yields when the seedlings were grown under glass.

The screen-base materials were far superior to the cloth-base materials in growing seedlings for outdoor planting.

Temperature under the various materials used in the test was rather uniform and was not considered an important factor in this comparison.

The glass substitutes are lighter, thus easier to handle; this is their only proven advantage over glass. The cloth-base materials are somewhat cheaper than glass or screen-base materials but are inferior in all other respects. Their short life makes them actually less economical than any of the other materials. The screen-base substitutes are far superior to the cloth-base materials for growing seedlings. At present their cost is prohibitive. There is evidence that the manufacturers of screen-base materials have greatly improved their product of late and with a further reduction in their cost, these materials may replace glass to a greater extent than is warranted at present.

At present the glass substitutes can only be recommended where ease of handling is of first importance, altho in the case of the screen-base materials, their resistance to breakage and heat-insulation properties may further justify their use.

SUMMER MANAGEMENT OF PULLETS

D. C. KENNARD AND R. M. BETHKE

The value of pullets in the fall and the returns to be secured from them as layers is largely determined by their feeding and management during the summer months. Pullets often come thru the brooding period in fine shape only to become inferior, diseased, and parasite-infested birds later because of faulty management. On the other hand, if the pullets have suffered some handicap during the brooding period the only hope for their recovery is proper summer management.

Either of two methods of management may be employed for summer development of pullets: 1, free range of blue grass, clover or alfalfa; 2, confinement to brooder or laying house with or without a wire screen sun parlor. Each method has its advantages and disadvantages under a given set of conditions, which differ with each poultry keeper.

The suggestions to follow are based upon tests and experience over a period of years at the Ohio Experiment Station's poultry plant and observations of practices and results secured by many progressive poultry keepers.

RANGE METHOD

The development of pullets on a suitable and adequate range is the only method that need be considered by poultry keepers in general, and particularly by farm poultry keepers. Confinement of growing pullets after they are past the need of artificial heat should be regarded as a method of last resort to be used only in case of necessity.

By suitable and adequate range for pullets is meant a range that is:

1. **Not seriously contaminated** with disease and parasites.
2. **Maintained exclusively for growing pullets,** never permitting mature stock to run over it.
3. **Capable of providing an abundance of green feeds,** such as blue grass, clover, or alfalfa.
4. **Large enough** so the birds can be ranged a considerable distance from the roosting shelter, or permit of frequent moving of roosting shelters to fresh ground.
5. **Shaded by trees or shrubs or shelters** to afford protection against heat of the sun.

Sometimes corn fields or wheat stubble may be used to advantage for ranging the pullets. Probably the best plan when practicable is to have two separate ranges so as never to use the same one two consecutive years.

Care of the range is next in importance to the range itself. A frequent and thoughtless mistake is to scatter droppings or litter from brooder or laying houses where pullets will later be ranged. This applies to the corn or wheat field which may later be used for ranging the pullets as well as to the exclusive range

Bare and contaminated ground around roosting shelters and feeding and drinking equipment is a hazardous condition to be guarded against. This can be prevented if every day or so the feeding and drinking equipment is moved 15 to 20 feet away from the roosting houses or shelters thus inducing the pullets to spend most of the day at a distance from the shelters. Pullets follow the feed and water in day time but at night will return to shelters unless they find suitable trees in which to roost. There should be no difficulty in getting the pullets to range 100 to 500 yards or more from the roosting quarters, provided shade of some kind is available to make the birds comfortable during the heat of the day. When there are no trees or shrubbery to provide shade it should be supplied by shelters of some kind. Trees suitable for roosting are often the best solution of the summer housing problem, especially for leghorns. Pullets roosting in trees are better protected against theft than if they were in houses or shelters. Where there are trees suitable for roosting, one 10 by 12 foot roosting shelter may serve for a considerable number of pullets, if more pullets are added as the others take to the trees. In this way the one shelter or brooder house may serve 200 to 300 pullets; whereas if all the pullets must continue to roost in the shelter, it will only accommodate 100.

The ground around the feeders and water troughs is often the worst menace to be found on the pullet range. Here, the greatest amount of droppings accumulate, and as there is always some feed on the ground close to feeders the chickens eat large quantities of the filthy soil in their attempt to secure the feed from the ground. Likewise around the drinking trough there may be puddles of water; so the birds will drink from filthy puddles in preference to clean drinking receptacles, or if the soil around the trough is only slightly moist as is usually the case, the birds will eat this wet, filthy soil. These dangerous conditions around feeders and water

receptacles can best be prevented by moving the equipment to fresh soil every two or three days. This prevents killing the grass and lessens the chances of contaminating the soil.

RANGE SHELTERS

Small colony brooder houses may be used for housing the pullets on range, but a range shelter such as the one shown in Figure 1 is preferable because it can be more easily moved and costs less. Plans may be secured upon request.

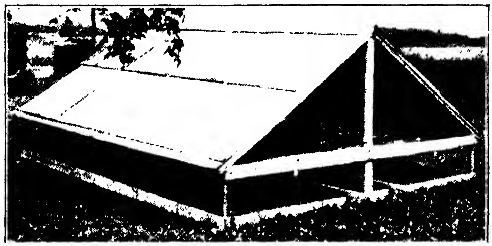

Fig. 1.—Portable summer range shelter

Suitable mash feeders (Fig. 2), and plenty of them, are required. The mash boxes may be made 3 to 4 inches deep, 6 to 8 inches wide (inside), and 4 to 10 feet long. Plaster laths are nailed on the top edges of the sides so as to extend inside three-quarters of an inch to prevent wastage of mash. A reel, made of plaster lath, or a revolving 2 by 2 inch pole, may be used to keep the pullets out of the mash box. Each 100 pullets should be provided with 20 feet of mash feeding space, counting both sides of the feeder.

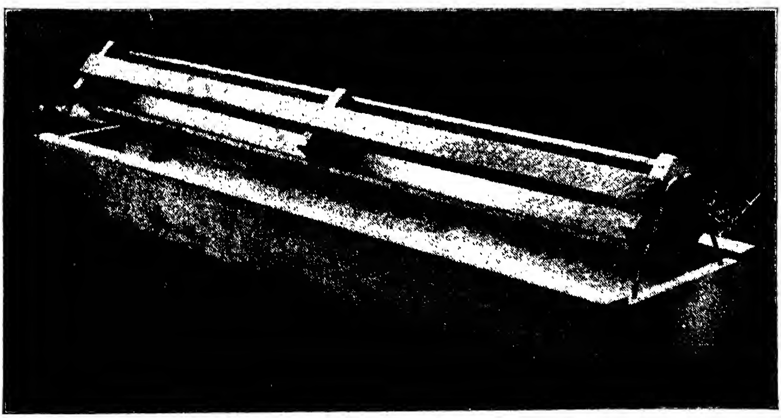

Fig. 2.—Reel mash feeder for use of pullets on summer range

This type of feeder is especially well adapted for pullets on the range because the desired amount of feeding space can be provided at a minimum expense, and it is waste proof since it need be filled only half full when fresh feed is supplied daily. The feeders are

easily moved to fresh ground, and are easily protected from rain and heat of the sun by simple shelters such as seen in (Fig. 3). Furthermore, when it is desired to feed grain and mash separately this type of feeder offers the best place for feeding the grain—simply put the grain on top of the mash.

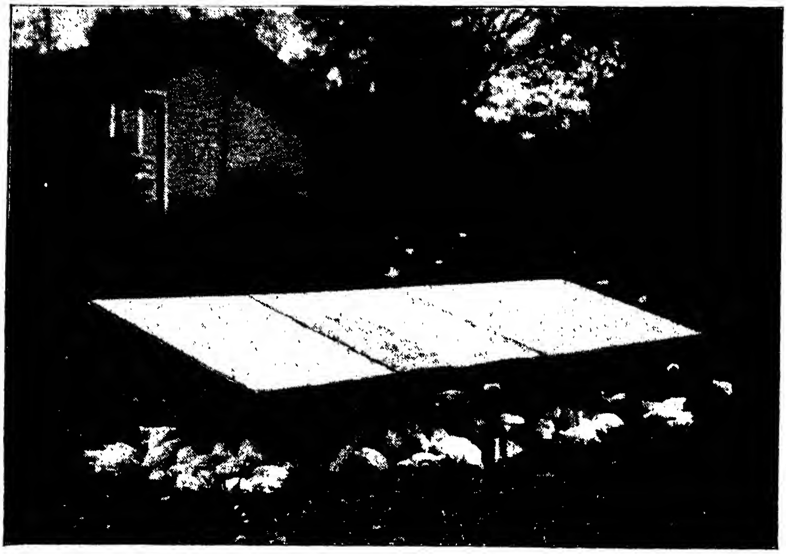

Fig. 3.—Shelters to protect mash feeders from rain and provide shade for pullets on summer range

FEEDING THE PULLETS

RATIONS

Formula No. 1, All-mash

For pullets on excellent range

Coarsely ground corn	70
Wheat middlings or coarsely ground wheat	25
Meat scraps, medium, (50 per cent protein)	5
Bone meal	2
Salt	1

Formula No. 2, All-mash

For pullets on poor range or confined

Coarsely ground corn	60
Wheat middlings or coarsely ground wheat	25
Meat scraps, medium, (50 per cent protein)	5
Dried buttermilk or skim milk	5
Alfalfa meal	5
Bone meal	2
Salt	½

A simple formula, No. 1, will prove satisfactory for pullets on a range which supplies an abundance of green feed. In case the range becomes depleted of green feed because of dry weather or large numbers of birds on a given area, then the simple ration should be supplemented with milk in some form and clover or alfalfa hay or alfalfa meal in the mash, as in formula No. 2.

METHOD OF FEEDING

For pullets on range, perhaps the best method is to feed each evening an amount of fresh mash that will be about consumed before the next feeding period. Many who are familiar with the all-mash method of feeding chicks will no doubt prefer to continue this practice with the pullets. The all-mash feed mixture may be made quite coarse as there will be no wastage from the pullets picking it over for the coarse material, if the feeders are never more than half filled. Furthermore, the pullets go to roost with better filled crops when fed a fresh coarse mash in the evening. As the finer part of the mash remaining will be about consumed before the next feeding they may as well be given the privilege of picking the coarser material from the fine in the evening. In fact, this is the principle involved in the feeding of grain and mash separately, the only difference being that the grain is fed in the mash feeder where it is kept clean, instead of feeding it in litter which is always more or less filthy. There are those who will prefer to feed grain and mash separately. If plenty of suitable mash feeders are provided the preferable method is to feed the grain in them daily on top of the mash. Another desirable procedure is to mix the grain whole or cracked with the mash in the desired proportion and feed as one feed mixture. This will reduce labor and skill of feeding the same as all-mash feeding. Others may desire to keep both grain and mash before the birds at all times in separate feeders. Any of these practices can be successfully employed. The method which best serves one may not suit another, depending upon the requirements and preferences of individual poultry keepers. While there is no "best" method of feeding or management for all, the once popular but faulty practice of feeding grain in litter or on the ground is obsolete so far as modern methods of poultry feeding are concerned.

RATE OF MATURITY

The feeding and managing of pullets so as to produce birds of desired size before they come into egg production is attended with much uncertainty. A popular contention and practice has been to

reduce the protein content of the ration to retard the sexual development, thus enabling the pullet to attain the desired body growth before laying. While this seems a logical theory, its application may involve difficulties and uncertainties which often make it a questionable practice, especially if carried to the extreme. In practice it seems that the developing ration for pullets on a suitable and adequate range should under no circumstances contain less than 5 per cent meat scraps containing 50 to 55 per cent protein, or its equivalent from milk, fish meal, oilmeals, etc., based on total feed intake of both grain and mash or all-mash. The protein requirement of pullets on a range which fails to supply an abundance of suitable green feed is higher. In that case 5 per cent each of meat scraps and dried skim milk or buttermilk as in Formula 2 makes a desirable combination and amount of protein to use, without unduly forcing the birds into early maturity.

If less than 5 per cent meat scraps is used the pullets may be denied the protein necessary for normal development. Such pullets are liable to suffer a loss of vigor which may make them more subject to disease and internal parasites. Furthermore, there appears to be no substantial evidence available to indicate that feeding pullets a low protein ration to retard their sexual development actually accomplishes the purpose. The present trend of thought and practice seems to favor the safer procedure of employing a ration with a moderate amount of protein to enable the pullet to develop at its normal rate, which will vary according to the breed or strain, rather than attempting the questionable practice of retarding development by reducing the protein below the minimum requirements for normal growth and development. Too often poultry keepers misjudge or become unduly alarmed about the rapid development of their pullets, because a few precocious pullets start laying at an early age; whereas the flock as a whole may be normal or even backward in their development.

GROWING PULLETS IN CONFINEMENT

Some poultry keepers are obliged to grow pullets in confinement as a measure of prevention or control of disease and parasites, or as a protection against varmints. Others may resort to confinement on account of a limited range or where the numbers of pullets are so large as to make it impracticable to provide suitable and adequate range conditions. In any event, more care and greater skill in feeding and management are required. Tests conducted by the Ohio Station with growth of pullets in confinement versus free

range indicate that either method may be equally successful provided that in each case the birds are properly fed and managed, and that the outdoor birds have a suitable range. There are four special requirements for successful growth of pullets in confinement:

1. **A complete ration,** with particular reference to green feed and direct sunlight, or their equivalents.
2. **Ample room**—2.5 to 3 square feet floor space per bird.
3. **Houses arranged** so as to afford greatest possible comfort during hot weather.
4. **Prevention and control of feather eating and cannibalism.**

Green feed and direct sunlight.—When the pullets are confined the poultry keeper is obliged to provide succulent green feed or a substitute such as clover, soybean, or alfalfa hay of special quality, or add 5 to 10 per cent alfalfa meal to the mash as indicated in Formula 2 previously noted. The birds must receive exposure to direct sunlight thru open windows, (Fig. 4) or by means of a sun parlor. If for some reason the direct sunlight is not available, it is necessary to substitute for it a potent cod-liver oil. Since milk functions as a partial substitute for green feed it makes a valuable addition to the ration for pullets to be grown in confinement.

Fig. 4.—A farm poultry keeper near Wooster, Ohio, used this straw loft laying house for brooding chicks and developing the pullets in confinement. The feeding and drinking equipment were placed just inside the windows so as to insure exposure of birds to direct sunlight, thus avoiding the use of cod-liver oil or a sun parlor. This arrangement, together with good management, proved highly successful.

Do not crowd.—Ample room is necessary for the proper development of the pullets and as a preventative of the vices of feather eating and cannibalism. The amount of floor space per pullet may vary from 2.5 to 3 square feet, depending upon the type of house and whether the birds have access to a sun parlor or not.

Feather picking and cannibalism.—The pullets must be carefully watched for any outbreak of these vices. If effective measures of prevention and control are exercised at the very beginning before the vices become established, usually no serious trouble will be experienced. The high points of prevention and control of such vices consist in tipping the beaks of the one or few guilty birds. The birds attacked should be caught and treated with pine tar if necessary. Tar is healing and generally repels further attacks. The house should be slightly darkened so the pullets are unable to pick feathers or flesh. This may be continued for one to four weeks depending upon the nature and severity of the outbreak. Confined pullets should be fed three times daily, or oftener, to keep them more contented.

HOUSING

Pullets on a good range find countless ways of making themselves comfortable during hot weather, but when confined they must depend upon the comfort and protection afforded against heat by the brooder, laying house, barn, or other buildings in which they are confined. Insulation affords protection against heat of sun in summer and conserves heat in winter. For summer comfort the insulation is most necessary under the rafters, to protect against the heat which radiates from the roof. This may be accomplished either by ceiling the under side of the rafters with matched lumber or insulating board in case of shed roofs, or if it is a double pitched roof, a straw loft or a ceiling may be put in 7 feet above the floor.

Regardless of the type of building, plenty of open space to allow free circulation of air is necessary. In fact, an open shed would serve well for housing pullets during the summer months, provided the roosting quarters could be protected against wind and rain when necessary.

It seems that the best and most practicable procedure for many poultry keepers who desire or find it necessary to confine their chickens is for them to brood the chicks in confinement until they are past the need of artificial heat, develop the pullets on a suitable and adequate range, and again confine the pullets as layers. This procedure protects the range from contamination by mature birds which are the principal carriers of disease and parasites. Furthermore, the range used exclusively for pullets, being free from chickens during the greater part of the year, would have a chance to become re-conditioned each year. This, together with proper precautions for the prevention of bare ground and dangerous contamination around the houses and feeding and drinking equipment, offers an effective and practical solution of the range problem.

STEER FEEDING ON PASTURE VS. FEEDING IN DRY LOT. II.

PAUL GERLAUGH

During the summer of 1928 steers fattened on blue grass pasture made more rapid and efficient gains than similar cattle fed in a barn. (Bimonthly Bulletin 138, May-June, 1929.)

Following the completion of the 1928 test the question arose as to whether the difference in favor of the pasture-fed cattle was due entirely to the grass portion of the ration, or whether part of the advantage might have been due to sunshine and possibly fresher air. As a result of this question the pasture feeding work of 1929 was arranged so as to obtain information on this point. Three lots of steers were fed. Lot 1 was fed in the barn, Lot 2 in an open shed with an outside dry lot, and Lot 3 was fed on blue grass pasture. The accompanying table shows the results obtained.

Again the cattle fattened on blue grass pasture outgained the cattle fed in either of the other two lots. They also required an appreciably smaller amount of shelled corn and protein concentrate to produce one hundred pounds of gain. While the average daily consumption of corn was the same for all lots during the entire period, the cattle fed on pasture did not eat as much corn daily as did the dry lot cattle during the first month on pasture. After the first month the pasture-fed cattle consumed larger quantities of corn than did the steers in the other lots.

The cattle in the barn and those in the open shed ate similar amounts of corn thruout the test. During the first two months of the test these two lots gained similarly. After that the open shed-fed cattle gained less than did the barn-fed cattle. It is probably true that the open-shed cattle suffered more from the heat and from flies than did the steers in the barn. Whether these two factors were responsible for the slightly slower gains is not known, but they probably were.

The three lots were appraised on November 9 by representatives of the Buffalo, Cleveland, Cincinnati, and Pittsburgh markets. The average feed lot appraisal is given with the marketing charge figured at 90 cents per hundredweight. The appraisers agreed that Lot 2 was valued below Lot 1 chiefly because of their unattractive coats of hair, and, to a limited extent, their slightly less degree of finish. The hair coats of the cattle in Lot 2 were sunburned so that the cattle appeared as "pasture-fed" cattle rather than "dry lot" fed

cattle. This lower valuation would surely indicate that if cattle are dry lot fed during the summer they should be confined to a closed shed so as to avoid sunburned and harsh coats of hair.

Hogs followed the cattle in the first two lots. Due to poor fences, no hogs followed the pasture-fed cattle. An estimated pork credit is given to the pasture cattle, based upon the average of the other two lots. The pigs salvaged sufficient corn following the steers to make about 1.5 pounds of gain from each bushel of corn fed to the steers.

TABLE 1.—Summary Sheet of Cattle Fed in Barn, Open Shed and Dry Lot, and on Pasture

	Lot 1 Barn	Lot 2 Open shed	Lot 3 Pasture
Steers per lot number	11	12	12
Average weight, May 28, pounds	656	658	664
Cost in feed lot, May 28	$13.10	$13.10	$13.10
Average weight, Nov. 12, pounds	979	956	1007
Average daily gain (168 days), pounds	**1.92**	**1.83**	**2.13**
Daily ration, pound			
Shelled corn	15	15	15
Linseed meal	1.1	1.1	1.1
Corn silage	15	17	Blue grass pasture
Mixed hay	1.3	1.3	
Feed per 100 lb. gain, pounds:			
Shelled corn	780	812	704
Linseed meal	60	63	54
Corn silage	789	904	Blue grass pasture
Mixed hay	68	68	
Cost of 100 lb. gain	**$17.85**	**$18.81**	**$16.11**
Necessary selling price (feed lot weight)	$14.66	$15.05	$14.26
Average market appraisal (feed lot weight)	$13.55	$12.60	$12.91
Loss per steer (pork not included)	$12.85	$23.45	$13.68
Pork credit per steer	$ 6.87	$ 6.73	$ 6.80*
Loss per steer (pork credited)	$ 5.98	$16.72	$ 6.88
Returns per bushel corn fed (pork credited)	$ .83	$ .59	$ .82
Shrink to Pittsburgh market, per cent	1.61	Not comparable	3.2
Dressing percentage	57.78		58.28

*Estimated. No hogs followed the pasture cattle because of poor fences.

Corn $0.98 per bushel; linseed meal $58, hay $14, silage $5.50 per ton; pasture 5 cents per steer per day. Ninety cents deducted from market appraisal to cover shipping.

Attention is called to the returns per bushel of corn fed. Had home-grown corn been used the returns per bushel of corn would have been considered quite satisfactory in spite of the fairly large loss per steer.

It is interesting to note that the pasture-fed cattle outdressed the dry-lot cattle on the basis of market weights. Using the feed lot weight in comparing the dressing percentages, the difference was not as marked as the valuations would indicate. The sleek appearance of the dry lot cattle may have been given more than just consideration.

This test would indicate that the advantages of feeding cattle on blue grass pasture are due to the grass consumed rather than to the outdoor air and the sunshine.

DICALCIUM PHOSPHATE AS A MINERAL SUPPLEMENT FOR DAIRY COWS

C. C. HAYDEN, C. F. MONROE, AND C. H. CRAWFORD

PART I. EFFECT ON HEALTH

That the practice of feeding mineral supplements to dairy cows has increased greatly during the last few years is indicated by the extensive sale of commercial mineral mixtures, the common use of such substances as steamed bone meal and ground limestone in home-mixed rations, and the prevalence of ready-mixed grain feeds containing "minerals".

Apparently the belief, which seems to have become general, that mineral supplements to the dairy ration are necessary has been due to: 1, outstanding benefits obtained by feeding minerals to hogs, chickens, and experimental rats; 2, favorable results obtained by feeding minerals to cattle on rations markedly deficient in calcium or phosphorus; 3, wide publicity given the results of some metabolism tests which have shown milking cows to be losing calcium and phosphorus at a rapid rate; 4, a few rather favorable results obtained in metabolism tests where mineral supplements were fed; 5, hopes that minerals might aid in preventing or overcoming the ravages of abortion disease and sterility.

Prominent authorities still differ as to the necessity for adding minerals to dairy rations. The general opinion seems to be that, inasmuch as they apparently do no harm and may do some good, their use is to be recommended until more is known about the requirements of dairy cows for such substances and their ability to utilize them. Therefore, mineral supplements are regarded by many as insurance against deficiencies which may occur. However, as it costs to carry insurance, the return should in general justify the expense.

From the work of various investigators it appears that high producing cows, that is, cows producing above 30 to 40 pounds of milk daily, lose calcium and phosphorus from their bodies. Even if they make good this loss during the latter part of the lactation, does it have any ill effects on their health? The object of the experiment here reported was to obtain information on this subject.

A small herd of cows was divided into two groups approximately equal in milk production at the beginning of the experiment.

Heifers raised in the herd were added to the two groups. The test covered a period of five years and eleven months, during which time 29 cows were used.

The two groups were cared for and fed alike except that one group received dicalcium phosphate, a commercial product precipitated from dissolved bone in the process of extracting gelatin from bone. This was fed at the rate of two pounds to every 98 pounds of grain. The ration usually consisted of mixed hay, corn silage, and a grain mixture containing corn, oats, oilmeal, bran, and cottonseed meal. The cows had access to pasture, this being supplemented with grain. Some soiling crops were fed during the last two summers.

The ration without the discalcium phosphate was reasonably well balanced, but it is doubtful if it contained enough minerals to prevent the loss of calcium and phosphorus from the bodies of the animals during the early part of lactation. The cows were liberally fed during the experiment as shown in Table 1.

TABLE 1.—Average Daily Feed Consumption per Cow for the Entire Experiment

	Grain	Hay	Silage	Pasture per lactation
	Lb.	*Lb.*	*Lb.*	*Days*
Mineral group	10.6	10.7	25.4	117.9
Non-mineral group	10.5	10.1	26.0	137.4

The cows in both groups kept in good condition. Any difference in physical appearance which may have existed between the two groups was not sufficiently outstanding to be detected by the men in charge or by various cattlemen who visited the herd.

During the course of the experiment only one cow in the herd reacted to the T. B. test. That this occurred in the non-mineral group was a matter of chance.

Calves born at mature time were uniformly thrifty and no difference was detected between those from the two groups.

The statement is sometimes made that minerals assist in preventing breeding troubles. In this experiment there was a slight indication that dicalcium phosphate had some beneficial effect. The data considered in this comparison of the breeding records of the two groups include 34 lactations in the mineral group and 22 lactations in the non-mineral group. Not all of the lactations were used, the following being discarded: Those that were followed by abortions or sterility; those where animals were sold for breeding

purposes; those where cows were not due until after the close of the experiment; and those begun before the experiment. The results of the comparison are shown in Table 2.

TABLE 2.—Average Length of Lactation, Days Dry, and Services per Calf

	Days in milk	Days dry	Services per calf
Mineral group	365	51	1.53
Non-mineral group	399	55	2.13

The average number of breedings per calf in the mineral group was 1.53 and in the non-mineral group 2.13. These figures were practically duplicated in the heifer breedings. Six heifers fed minerals required 1.5 breedings, while 7 heifers without minerals required an average of 2.1 breedings. In the mineral group 88 per cent of the conceptions required 1 or 2 breedings and 12 per cent required 3 breedings. In the non-mineral group 59 per cent of the conceptions required 1 or 2 breedings, 27 per cent 3 breedings, 9 per cent 4 breedings, and 4 per cent 6 breedings. The fewer breedings in the mineral group are slightly significant statistically.

Abortions occurred 4 times in the mineral group and once in the non-mineral group. Permanent sterility occurred 3 times in the mineral and 4 in the non-mineral group.

TABLE 3.—Cases of Abortion, Sterility, and Tuberculosis

	Mineral group	Non-mineral group
Abortion	4	1
Sterility	3	4
T. B.	0	1

There were cases of retained placenta in both groups.

It is possible that the dicalcium phosphate aided some in the matter of conceptions, but it is evident that it did not prevent abortions, sterility, or retained placentae. Table 3 shows the cases of abortion, sterility, and tuberculosis occurring in the herd.

SUMMARY

In this experiment no marked beneficial or detrimental results on the health of cows fed dicalcium phosphate were obtained. This agrees quite well with results obtained at some other experiment stations under similar conditions. The indications seem to be that marked improvement in the health of cows fed minerals need not be expected when the usual ration is not markedly deficient in minerals or the cows are not very high producers.

THE DAIRY FEED—MILK RATIO FOR NORTHEASTERN OHIO

J. H. SITTERLEY

Profits in the dairy industry depend on the margin between the cost of milk production and the amount received for the product. Feed, labor, and overhead are the main items of cost that enter into production. Of the total cost of milk production according to cost studies in Medina County, 45 to 55 per cent was feed of which fully 50 per cent was concentrates. The price of concentrated feed varies from month to month and year to year, while the labor and overhead costs remain fairly constant.

TABLE 1.—The Ratio of the Price of Dairy Feed to the Price of Milk

Year	Cleveland milk price	Feed price per cwt.	Equivalent in feed of 100 lb. of milk
	Dol.	*Dol.*	*Lb.*
1920	3.40	3.09	110
1921	2.45	1.57	156
1922	2.01	1.61	125
1923	2.72	1.77	154
1924	2.41	1.87	129
1925	2.55	1.92	133
1926	2.49	1.63	153
1927	2.51	1.73	145
1928	2.46	2.04	120
1929	2.41	1.93	126
10-year average	2.54	1.86	136

In the accompanying table and chart a comparison is made for the past ten years of the amount of concentrated dairy feed[1] one hundred pounds of milk would buy. Northeastern Ohio feed prices and Cleveland milk prices were used.

The ratio of the price of dairy feed to the price of milk has been below the ten-year average for most of 1928 and 1929. Feed prices for both years were above average, while milk prices for the same period were somewhat below average. For the past ten years in Northeastern Ohio one hundred pounds of milk has equalled in price 136 pounds of dairy concentrates, or one pound of dairy concentrates has been equivalent in price to approximately three quarters of a pound of milk.

[1]The amount and variety of feeds used in the dairy ration were based on the results of the Medina County cost study. The ration used was as follows:

Corn 29 lb., oats 28 lb., oilmeal 16 lb., cottonseed meal 10 lb., bran 14 lb., and gluten 3 lb.

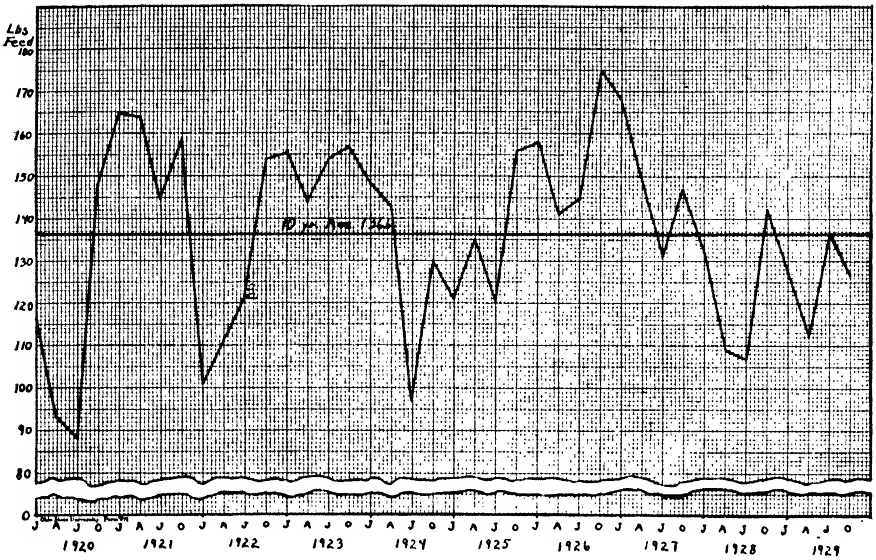

Fig. 1.—The equivalent in dairy feed of 100 pounds of milk

LAND UTILIZATION

J. I. FALCONER

The census of 1925 revealed the fact that at that time 85.2 per cent of the land in Ohio was in farms. This left over 3,850,000 acres of land in the state lying outside farms according to the census definition.

As to the use made of this land there is no very definite information. Highways and water comprise a minor part. Residential sites, villages, towns, and cities take up a considerable area, as is shown by the fact that in Cuyahoga County only 44 per cent of the land is in farms, in Lucas County only 57 per cent, and in Hamilton County only 63 per cent. The low percentage of land in northeastern Ohio reported as in farms is partly due to the prevalence of cities.

To account for the low percentage of land reported as in farms in some counties it is necessary to take into consideration the method of taking the census. A tract of land on which no one lives or which is not rented, for agricultural use, by another party is not included in the census enumeration. This leads to the omission

from the census enumeration of large areas of land in the poorer agricultural areas of the state. Pike County, for instance, reports only 79 per cent of its lands in land. This county has no great

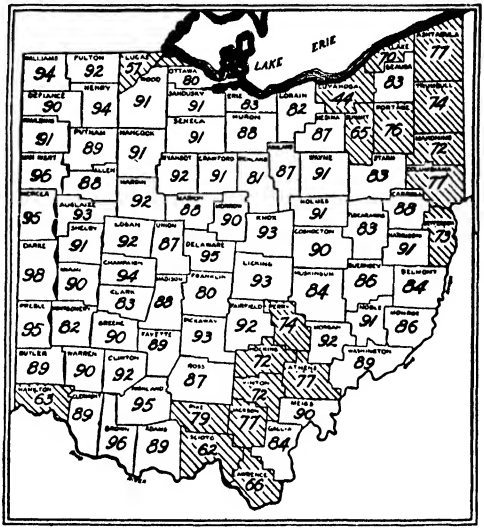

Fig. 1.—Per cent of land in farms, 1925

amount of land in town or city sites; it is, therefore, fair to assume that the remainder of the land is virtually lying idle. In a group of southeastern counties this type of land comprises a considerable area which has in recent years been increasing.

COMPARATIVE PRICES OF OHIO FARM PRODUCTS

J. I. FALCONER

In the accompanying table a comparison is made of the prices of the different Ohio farm products with each other and with the price level prevailing in previous years. The products have been listed according to their price level during the period 1925-28, when they were compared with pre-war prices. Lambs appear at the top of the list, having brought during the period 1925-28 double the pre-war price; horses are at the bottom, having averaged in price only 64 per cent of the pre-war level. Sheep, poultry, dairy products, and potatoes brought the highest relative prices during the period; oats, hay, and horses brought the lowest.

While Ohio farm prices as a whole were at nearly the same level in 1929 as in the four-year period 1925-28, there were several changes in the price level of individual commodities. Wheat and wool were notably lower in price; beef cattle and milk cows higher, having shown marked increases in price during the years 1928 and 1929. Milk prices held up well until the close of the year. The

TABLE 1.—Relative Price of Ohio Farm Products

Item	Units	Average price				Index of prices†			
		1910-14	1925-28	1928	1929	1921-24	1925-28	1928	1929
		Dol.	*Dol.*	*Dol.*	*Dol.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Lambs	Cwt.	6.05	12.20	12.17	12.10	166.4	210.5	208.3	207.5
Potatoes	Bu.	.77	1.52	1.093	1.083	156.5	197.6	146.0	144.4
Chickens	Lb.	.12	.22	.226	.242	174.6	190.9	195.8	208.0
Wool	Lb.	.22	.41	.42	.36	170.7	186.3	199.0	168.8
Butter	Lb.	.25	.44	.47	.46	157.7	175.6	190.0	188.0
Milk*	Cwt.	1.55	2.61	2.65	2.69	159.3	168.3	171.0	173.0
Sheep	Cwt.	4.10	6.51	6.80	6.55	126.2	167.0	174.7	167.1
Wheat	Bu	.96	1.457	1.438	1.20	123.6	150.0	148.3	124.0
Milk cows	Head	52.67	78.20	98.08	98.50	113.6	148.4	190.0	190.0
Eggs	Doz.	.22	.33	.327	.347	143.7	148.2	148.0	157.0
Hogs	Cwt.	7.62	10.94	9.35	10.14	108.2	143.5	125.0	136.1
Corn	Bu.	.62	.86	.95	.92	117.9	139.3	154.0	150.0
Beef	Cwt.	6.02	8.27	10.23	10.17	109.6	137.3	173.0	171.0
Oats	Bu.	.402	.45	.508	.455	106.7	112.1	126.0	113.0
Hay	Ton	14.20	11.90	9.90	10.70	93.0	83.8	71.0	77.0
Horses	Head	163.60	105.10	116.00	118.00	64.3	64.2	71.0	72.0
All Ohio farm products	......	....	....	....	....	131.5	153.0	153.0	152.0

*Straight average of Cleveland, Columbus, and Pittsburgh milk.
†1910-14=100.

1929 potato crop sold for a good price. Hogs were lower in price than the four-year average but higher than in 1928. Altho prices for agricultural products as a whole for 1929 were slightly less than for 1928 the income from sales was about 5 per cent greater, due mainly to the larger wheat crop of 1929.

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

Since August, 1929, the price level of Ohio farm products has been declining until in February, 1930, it reached the lowest level since 1924. Non-agricultural products have also declined in price but not to the same extent. The most notable decline has been in butterfat which fell from 45 cents in October to 34 cents in February. Milk fell from \$2.63 per hundred in November to \$2.36 in

February. Wheat and corn which were selling for $1.34 and 98 cents per bushel in February of 1929 were quoted at $1.12 and 74 cents, respectively, in February, 1930; lambs selling at an average farm price of $13.40 per cwt. a year ago were $10.70 in February of 1930; wool prices dropped from 42 cents per pound in February, 1929, to 24 cents in February, 1930. Potatoes and apples were higher than one year ago, while hogs and beef cattle were selling at about the same price.

Trend of Prices and Wages, 1910-1914=100

	Wholesale prices all commodities U. S.	Weekly earnings N. Y. state factory workers	Prices paid by farmers for commodities bought U. S.	Farm products prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm products prices	Ohio cash income from sales
1913........	102	....	100	100	104	100	105	100
1914........	100	100	101	102	102	102	105	107
1915........	103	101	106	100	103	107	106	110
1916........	[illegible]	114	123	117	113	113	121	120
1917........	181	129	150	176	140	119	182	197
1918........	198	160	178	100	175	131	203	243
1919........	210	185	205	209	204	135	218	265
1920........	230	222	206	205	236	149	212	242
1921........	150	103	156	116	164	134	132	136
1922........	152	297	152	125	145	124	127	135
1923	156	214	153	135	166	122	134	148
1924........	152	218	154	134	165	118	133	150
1925	161	223	159	146	165	110	159	164
1926........	154	229	156	136	170	105	155	176
1927........	149	231	154	131	173	99	147	163
1928........	153	232	156	139	169	96	154	147
1929........	151	236	155	138	169	94	151	154
1929								
January...	152	234	156	133	166	....	144	145
February..	151	236	156	136	....	....	149	137
March....	153	239	156	140	....	94	155	143
April.....	152	237	155	138	163	....	150	148
May.	150	236	155	136	....	....	152	149
June......	151	236	155	135	....	....	153	155
July......	154	235	155	140	172	....	157	174
August...	153	237	155	143	....	....	159	163
September.	153	240	155	141	....	....	153	160
October...	151	237	155	140	174	....	151	166
November.	148	233	155	136	....	....	149	159
December..	148	234	155	135	....	....	147	146
1930								
January...	148	235	155	134	158	....	141	152
February..	146	....	....	131	....	....	137	134

FIELD DAYS AT THE EXPERIMENT STATION

Better Lawns Day, Thursday, June 5
Poultry Day, Thursday, June 19
Wheat and Clover Day, Friday, June 20
Orchard Day, Friday, August 15
Dairy Day, about the middle of August

The Bimonthly Bulletin

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Ohio Agricultural Experiment Station

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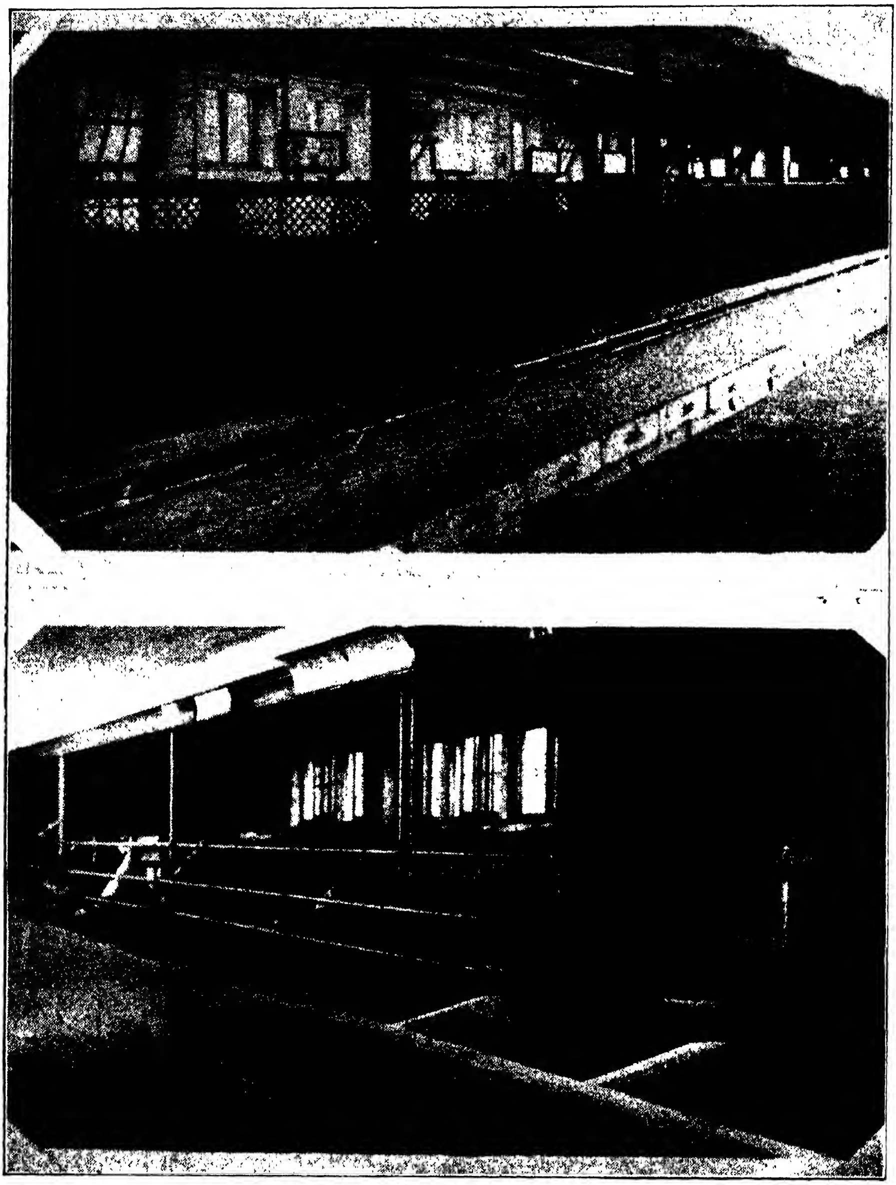
Free Bulletin

C. G. Williams

Director



Two Types of Stalls in Use in the Dairy Barn at the Ohio Experiment Station

THE INFLUENCE OF THE INSECT FACTOR IN DETERMINING CROP ROTATIONS

C. R. NEISWANDER

Reports of severe insect injury to various crops are received at the Experiment Station every year. Frequently the occurrence of these outbreaks can be attributed to (1) the method of field transfer from one crop to another, (2) the type of crop used in the rotation, or (3) the nature of plant spacing in the succeeding crop. Sometimes the injury could be readily avoided if the occurrence of the insects in great abundance had been foreseen and the contributing factors taken into consideration.

Insect populations become adjusted numerically to their environments. The longer a given crop, such as timothy or blue grass, is grown within a field the greater will be the opportunity for accumulation of different species of insects and also of individuals within the species. Accordingly, it frequently happens that where one crop variety is grown for a number of years the insects associated with that crop become extremely abundant. This is especially true with crops like the grasses where there is complete coverage of the ground surface, and the developing population has an abundant food supply in all directions.

This accumulation of destructive insect populations can sometimes be prevented by manipulating the rotations so that a definite limit is placed on the number of consecutive years a crop is grown in one field. Particularly is this true of the lined stalk borer or "heart worm", *Oligia fractilinea* Grote, which has been known to injure corn only when planted in a field that had been in timothy for two successive years or longer. Usually most severe injury occurs in fields that have been in timothy for as long as four or five years. If timothy fields were not permitted to stand for more than two consecutive years, injury by this species would undoubtedly be greatly reduced. The same condition applies in a measure to the occurrence of other insect species in this crop and other crops.

When high insect populations occur or when such cropping conditions exist as would indicate the presence of large numbers of destructive insects, either the accumulated insect population should be in a measure disposed of before replacing the crop variety with a

differently growing type of plant, or else the cropping system should be such that the insects will do but little damage in spite of their abundance.

1. **Method of field transfer from one crop to another.**—It frequently happens, in case of certain types of insects, that the insect population of a field can be almost completely obliterated by the farming practices that have to do with crop rotations. For instance, the lined stalk borer, even with high populations, can be largely prevented from becoming injurious by fall plowing of the timothy field in which the insect normally lives, this treatment apparently being instrumental in reducing the hibernating population. The practice of fall plowing is effective in decreasing the number of insects of a great many different species. This is true of cut worms, bill bugs, white grubs, and others. In some cases the effectiveness of the practice may be due to (1) mechanical injury to the insects, (2) a disturbing of their hibernating quarters that thus results in their exposure to the rigors of winter, or (3) to the starvation that follows from the lapse of time between the plowing of the field and the appearance of the new crop.

2. **Types of crops used in rotation.**—Many insect species are limited to a few species of plants for their food material. The food plants of a given insect species are usually similar and closely related. Since this is the case it is frequently profitable to grow as successive crops those that are unlike and not closely related. For instance many of the common grass insects feed readily upon corn since it is also a grass. For this reason the likelihood of injury to corn is much less when it follows a legume such as clover or alfalfa. Since it is usually considered a good practice from an agronomic standpoint to vary the type of crop grown in a given field it is doubly advisable because of the relation to insect injury.

3. **Nature of plant spacing in succeeding crop.**—A third phase of the insect factor as it deals with rotation of crops is the nature of growth of the two successive crops in the rotation. If the insect population has not been reduced by farm practices such as fall plowing or by selecting a non-susceptible type of plant for the successive crop in the rotation, the injury can frequently be held at a minimum by considering a third factor that affects insect injury; namely, the manner of growth or the spacing of plants in a field immediately following a crop that supported a high population of insects.

When corn is grown following a grass sod that completely covers the ground, the insects in the sod become concentrated on a

relatively few plants because of the fact that corn is normally grown in hills spaced three and a half feet each way. This means that all of the insects within an area comprising $12\frac{1}{4}$ square feet, in order to survive, will have to congregate on the hill of corn. Because of this concentration of insects on a relatively few plants, corn after sod of several years standing frequently suffers conspicuous injury by cut worms, sod webworms, and bill bugs. For this reason, as a final precaution against severe injury, a field that is thought to have a large population of insects should be followed in the rotation by a closely spaced type of crop such as the small grains or a legume in preference to one such as corn, potatoes, or tomatoes.

WHITE GRUB INJURY

During the present season in some sections of Ohio there will undoubtedly be considerable injury by white grubs to corn, potatoes, and similarly spaced crops. The grubs form the larval stage of the large insects known as May beetles or "June bugs" which were in flight very abundantly during the summer of 1929. These insects normally require three years in which to complete their life cycle. Consequently severe injury occurs but once in three years. The larvae that are now developing from the eggs laid by the beetles last summer (1929) will be in their most injurious stage during the summer months of this year. Consequently, in regions susceptible to injury by these species it will undoubtedly be profitable to take every precaution against them.

Most investigators agree that the eggs of May beetles are laid most abundantly in grass lands in rather close proximity to trees and that grass roots form the natural food of the larvae. Clover and alfalfa, on the other hand, are not very susceptible to injury. If rotations can be arranged in such a way that during the year of severe injury crops like corn are not grown after a grass sod the injury can be largely avoided. It is therefore urged that in the regions where white grubs are frequently injurious, farmers refrain from planting corn or potatoes on sod land unless the field had been plowed early in the fall so that the grubs would have been largely killed off before going into hibernation.

CONCLUSIONS

In planning crop rotations the insect factor should be constantly borne in mind. While extended outbreaks of most farm crop insects occur rather sporadically it is nevertheless advisable to select rotations in which destructive insects can be kept at a

minimum. This end may be accomplished (1) by using in the rotation a crop non-susceptible to injury by the insects that attacked the preceding crop, or (2) by following high accumulations of insects with crops whose nature of growth eliminates in a measure the destructiveness of the insects present. In all cases the rotations accepted can and should be in accordance with good agronomic practices.

FIBER IN RATIONS FOR GROWING AND FATTENING PIGS

W. L. ROBISON

Fiber is the term used to designate the woody portion of a feeding stuff. Concentrates are those feeds like the grains or by-products which are relatively low in fiber. The coarser feeding stuffs, such as the hays, straws, corn stover, etc., are relatively high in fiber and are classed as roughages. Cattle, sheep, and horses consume relatively large amounts of roughage. Because of the nature of their digestive tract swine cannot utilize to advantage a great deal of roughage in their ration. Bulky or fibrous rations are particularly objectionable for young pigs when rapid growth is desired.

Several experiments have been conducted at the Ohio Experiment Station which furnish data concerning the effect of fiber in rations for growing and fattening pigs which substantiate those obtained elsewhere. Some of the Ohio experiments were planned for the purpose of studying specifically the influence of fiber in the ration. Others were conducted primarily for other purposes but, nevertheless, provide information of interest concerning fiber.

Ground peanut shells were chosen as the source of fiber in one experiment. They contain approximately 60.8 per cent fiber. Aside from being highly fibrous, they probably supply very little of nutritive value except possibly minerals.

A low-fiber basal ration was made up of yellow corn flour, supplemented with dried milk albumen. Corn flour contains approximately 0.7 per cent fiber. Dried milk albumen is a by-product of the manufacture of milk sugar and is dried skimmilk from which the milk sugar has been removed. Like other milk products, it is free from fiber. The basal ration thus contained less

than 1 per cent fiber. To this were added varying amounts of peanut hulls to form rations containing approximately 2.7, 5.8, and 12.1 per cent fiber, respectively.

Several pigs on the basal ration and on the one containing the lowest percentage of peanut hulls scoured so badly it was necessary to remove them from the lots. The extreme laxativeness of these rations proved to be such a disturbing factor that the data for the two lots are omitted. Peanut hulls, when fed at the higher levels, tended to prevent the scouring. The results from feeding these two rations are shown in Table 1.

TABLE 1.—Peanut Hulls as a Source of Fiber in Rations for Growing and Fattening Pigs. I

	Lot 1 Corn flour 75 Dried milk albumen 10 **Peanut Hulls 8**	Lot 2 Corn flour 75 Dried milk albumen 10 **Peanut Hulls 20**
Approximate fiber in ration, per cent	5.8	12.1
Number of pigs	5	5
Initial weight per pig, pounds	61.9	61.8
Final weight per pig, pounds	195	198.5
Average daily gain, pounds	1.27	1.08
Days required to gain 150 pounds	118	138
Daily feed per pig, pounds:		
Corn flour*	3.88	3.37
Dried milk albumen	.42	.39
Peanut hulls	.40	.89
Total	4.70	4.65
Feed per 100 lb. gain, pounds:		
Corn flour*	304.46	311.08
Dried milk albumen	33.34	36.24
Peanut hulls	31.79	81.72
Total	369.59	429.04
Fiber-free feed per 100 lb. gain	348.16	377.13
Worth of ration a ton, with that for Lot 1 valued at $37.20	$37.20	$32.05

*For the first 18 days corn instead of corn flour was fed. This is included with the corn flour and makes up .57 and .35 pound of the daily feed; and 44.78 and 32.19 pounds of feed per 100 pounds of gain, respectively.

In a later experiment, to equal parts of corn flour and corn red dog flour, used as the carbonaceous portion of the ration, equal parts of dried milk albumen and fish meal were added. This basal ration, containing approximately 0.75 per cent fiber, was fed to one group of pigs; other groups were given the same feeds with sufficient peanut hulls added to provide rations containing approximately 3, 6, 9, and 12 per cent fiber, respectively.

That only a very small amount of fiber is needed in the ration to maintain the health and well-being of pigs during the growing and fattening period is indicated by the excellent gains and the low feed requirement per unit of gain for the pigs of Lot 1. With the

exception of the ration fed Lot 5, each increase in the percentage of fiber decreased the rate of growth and increased the feed required for each 100 pounds of gain produced.

TABLE 2.—Peanut Hulls as a Source of Fiber in Rations for Growing and Fattening Pigs. II

	Lot 1 Basal ration	Lot 2 Basal ration 96 Peanut Hulls 4	Lot 3 Basal ration 26 Peanut Hulls 9	Lot 4 Basal ration 86 Peanut Hulls 14	Lot 5 Basal ration 81 Peanut Hulls 19
Approximate fiber in ration, per cent	.75	3	6	9	12
Number of pigs	4	4	4	4	4
Initial weight per pig, pounds	47.1	47.2	45.9	46.9	46.6
Final weight per pig, pounds	207.4	207.6	203.9	209.7	205.7
Average daily gain, pounds	**1.53**	**1.43**	**1.25**	**1.22**	**1.26**
Days required to gain 150 lb.	98	105	120	123	119
Daily feed per pig, pounds:					
Carbonaceous feed*	4.71	4.65	4.31	4.19	3.90
Supplement†	.45	.47	.49	.51	.52
Peanut hulls	....	.22	.47	.77	1.04
Total	**5.16**	**5.34**	**5.27**	**5.47**	**5.46**
Feed per 100 lb. gain, pounds:					
Carbonaceous feed	308.77	325.07	343.85	342.31	308.93
Supplement	29.45	32.96	38.94	42.15	41.54
Peanut hulls	....	14.92	37.86	62.59	82.21
Total	**338.22**	**372.95**	**420.65**	**447.05**	**432.68**
Fiber-free feed per 100 lb. gain	335.68	361.14	395.41	406.81	380.76
Worth of ration a ton with that for Lot 2 at $40.00	$44.11	$40.00	$35.46	$33.37	$34.48

*Carbonaceous feed made up of equal parts yellow corn flour and corn red dog.
†Supplement made up of equal parts dried milk albumen and fish meal.

Oat hulls contain about 29.2 per cent fiber and are almost as woody in character as is oat straw. Because of their bulky or fibrous nature, due to the presence of the hulls, oats usually produce relatively slow and costly gains when they are fed as the only grain to growing and fattening pigs. To study the effect of hulled oats in the ration a mixture of 12 parts of hulled oats and 1 part of tankage was fed to one group of pigs. Two other groups were given the same ration containing 10.3 and 22 per cent of ground oat hulls, respectively, and a fourth was fed a mixture of 12 parts of ground oats and 1 part of tankage. The oats used weighed 32.5 pounds to the bushel, 29.7 per cent of which was hull. Thus, the four rations contained approximately 1.6, 4.3, 7.4, and 10.4 per cent fiber, respectively.

By the time the pigs on the hulled-oats rations averaged about 175 pounds in weight some of them had become stiff or lame and were either losing in weight or gaining very slowly. This indicated that these rations were deficient in minerals, or the antirachitic vitamin, or both, and were not suitable for feeding under indoor conditions. For this reason these lots were discontinued at the

close of the seventeenth week. The data given in Table 3 show the results obtained from the various rations until an average weight of 166 to 169 pounds was reached. The group of pigs given oats, and another given corn in the same experiment did not become stiff, altho they were continued until they averaged 230 pounds in weight.

TABLE 3.—Oat Hulls as a Source of Fiber in Rations for Growing and Fattening Pigs. I

	Lot 1 Hulled oats 72 Tankage 6	Lot 2 Hulled oats 72 Tankage 6 Oat Hulls 9	Lot 3 Hulled oats 72 Tankage 6 Oat Hulls 22	Lot 4 Oats 72 Tankage 6
Approximate fiber in ration, per cent	1.57	4.34	7.38	10.43
Number of pigs	5	5	4	5
Initial weight per pig, pounds	47.7	47.3	46.7	48
Final weight per pig, pounds	169.1	168.1	166.2	166.4
Average daily gain, pounds	1.24	1.05	1.00	1.06
Days required to gain 125 pounds	101	119	125	118
Daily feed per pig, pounds:				
Hulled oats or oats	3.58	3.10	3.09	4.25
Tankage	.30	.26	.26	.35
Oat hulls	....	.39	.94	....
Total	3.88	3.74	4.29	4.60
Feed per 100 lb. gain, pounds:				
Hulled oats or oats	288.94	295.62	307.43	401.66
Tankage	24.08	24.63	25.62	33.47
Oat hulls	....	36.95	93.94	....
Total	313.02	357.20	426.99	435.13
Fiber-free feed per 100 lb. gain	308.10	341.70	395.48	389.75
Worth of ration per ton with that for Lot 2 valued at $38.67	$44.13	$38.67	$32.35	$31.74

With the exception of the lot fed ground oats, each increase in the percentage of fiber reduced the rate of growth and the gains from a given quantity of feed, exclusive of fiber. The relatively favorable showing made by the oats-fed pigs is explained by the fact that one pig in each of the other lots became stiff or crampy, and failed to gain during the latter part of the feeding period. Thus, while pigs ordinarily grow faster as they become older, those in Lot 1 gained 1.34 pounds daily for the first 9 weeks and 1.24 pounds daily for the entire period of 14 weeks.

That the lameness of the pigs fed hulled oats was due to a mineral and vitamin deficiency, rather than to a lack of sufficient bulk or fiber in the ration, was shown by a later test, in which 6 out of 7 pigs receiving hulled oats, tankage, and minerals became stiff or crampy in from 10 to 14 weeks, and were cured by the addition of cod-liver oil to the ration. Including three per cent of ground alfalfa in the ration prevented the development of lameness in pigs of a second group similarly fed.

Table 4 summarizes the results of three experiments in which oats and hulled oats were fed to growing and fattening pigs. In one of these, tankage was fed as a supplement. In another the supplemental mixture was made up of tankage, ground alfalfa, and minerals; while in the third it consisted of tankage, linseed meal, ground alfalfa, and minerals. The rations containing hulled oats and those containing unhulled oats averaged approximately 2.4 and 11.0 per cent of fiber, respectively. Commercial hulled oats were used. Since the unhulled oats and hulled oats were not obtained from the same supply there is a possibility that other differences in the feed may have influenced the comparative results to some extent. That the differences, however, were due chiefly to the presence or absence of the hulls is probably a fairly safe assumption.

TABLE 4.—Oat Hulls as a Source of Fiber in Rations for Growing and Fattening Pigs. II

	Lot 1 Hulled oats	Lot 2 Unhulled oats
Approximate fiber in ration, per cent	2.4	11.0
Number of comparisons	3	3
Number of pigs	21	23
Initial weight per pig, pounds	50.1	50.2
Final weight per pig, pounds	190.2	189.2
Average daily gain, pounds	1.25	.95
Days required to gain 150 lb.	120	158
Daily feed per pig, pounds:		
Oats	3.38	4.24
Protein supplement	.21	.18
Ground alfalfa	.08	.11
Minerals	.04	.05
Total	3.71	4.58
Feed per 100 lb. gain, pounds:		
Oats	270.96	446.83
Protein supplement	16.41	18.86
Ground alfalfa	6.74	11.28
Minerals	3.37	5.64
Total	297.49	482.61
Fiber-free feed per 100 lb. gain	290.46	429.43
Worth of ration a ton with that for Lot 1 at $40.60	$40.60	$25.03

With few exceptions, in the experiments reported an increase in the fiber content of the ration increased the feed required per unit of gain, even with the feed calculated on a fiber-free basis. Apparently the pigs did not have the capacity to eat enough of the fibrous, or bulky, feeds to make rapid growth. Their slower rate of growth, and consequently greater maintenance requirement, probably explains their higher fiber-free feed consumption per unit of gain.

To illustrate the effect of fiber on the worth of a ration, the relative prices at which each ration must have sold in order for the

feed cost to have been the same, are shown. While the differences vary, for purposes of estimation it can probably be assumed that each per cent increase in fiber reduced the worth of a ration at least $1.00 per ton. On this assumption if two rations were equal in other respects, one containing 3 per cent fiber would be worth $3.00 per ton more than one containing 6 per cent fiber. These data are on a basis of $40.00 per ton for a ration containing 3 per cent fiber. With lower prices the difference in value per ton would be less, of course, while with higher prices it would be greater.

The data apply to the entire ration rather than to a portion of it. Corn of No. 3 grade contains approximately 3 per cent fiber and 9½ per cent protein. As the protein content of feeds to be used with corn increases, the effect of the fiber in reducing its worth per ton becomes less marked. To provide a ration containing 15 per cent protein, 1.8 pounds of an 18 per cent protein feed for every pound of corn fed would be needed. If the 18 per cent protein feed contained 8 per cent fiber the resulting ration would contain 5.8 per cent fiber. On the other hand, only 1 pound of a 43 per cent protein feed for every 5 pounds of corn would be required. If it contained 8 per cent fiber the resulting ration would have a fiber content of 2.9 per cent.

Under certain conditions a reasonable amount of fiber in the ration may be desirable. Pigs fed a relatively bulky ration tend to grow rather than fatten. Those fed unhulled oats in the experiment reported in Table 4 were thinner and growthier at 200 pounds than were those fed hulled oats. It is not considered desirable for pigs that are intended for breeding purposes to be allowed to become extremely fat; hence, more fiber in their ration is advisable than is the case with fattening pigs. Bulk or fiber in the ration can easily be supplied thru pasture crops or relatively low-priced home-grown leguminous hay. Ground, leafy, leguminous hay is often included as an economical source of vitamins and minerals in rations for young pigs. If fed in too large amounts,. however, the excessive amount of fiber furnished would be a disadvantage.

DICALCIUM PHOSPHATE AS A MINERAL SUPPLEMENT FOR DAIRY COWS

C. C. HAYDEN, C. F. MONROE, AND C. H. CRAWFORD

PART II. EFFECT ON MILK PRODUCTION

In the May-June (1930) issue of the Bimonthly Bulletin the effect of feeding dicalcium phosphate on the health of the dairy herd was discussed. The plan of the experiment was presented in that article; the effect of the mineral supplement on milk production is here presented.

While experiments have shown that cows producing large amounts of milk are likely to be losing mineral matter from their bodies, the effects of feeding mineral supplements have been somewhat disappointing in that they do not markedly reduce the losses. Apparently they are not readily utilized as are other nutrients. This may be due to the fact that the utilization of calcium requires the presence of vitamin D found in green feeds and high-quality hay.

Experiments conducted at the Delaware Station with limestone, at the Arizona Station with lime, bone meal, and sodium phosphate, and at the Illinois Station with bone meal have shown little or no effect on milk production.

In contrast with these results are those obtained by Dr. Meigs of the United States Department of Agriculture, who found that feeding disodium phosphate to a herd of cows did not cause any immediate increase of milk, but that a marked increase occurred during the next lactation period.

TABLE 1.—Effect of Dicalcium Phosphate on Milk Production

	Daily milk	Daily fat
	Lb.	*Lb.*
Mineral group	30.54	1.039
Non-mineral group	29.73	1.026
Difference	.81	.013

The experiment here reported does not reveal any appreciable increase in milk production from the feeding of dicalcium phosphate, altho the yields of both milk and fat were slightly higher in the group of cows receiving the mineral, Table 1.

There are variable factors entering into an experiment of this nature for which corrections need to be made. There was some difference in the quality of the milk produced by the two groups, considerable variation in the length of lactation periods, and some difference in the average age of the cows in the two groups. The true measure of efficiency of a ration is the amount of nutrients returned in the milk. In order to overcome at least a part of the difference in quality of the milk produced by the mineral and non-mineral groups, the milk was calculated to a 4 per cent fat basis by use of the Gaines formula (F. C. M.=.4M+15 fat). With this correction the mineral group produced daily 27.81 pounds of milk and the non-mineral group 27.23 pounds. This leaves the mineral group still slightly ahead.

Perhaps the fairest comparison in this experiment may be made by eliminating parts of lactation periods, taking the first seven months of each of the full lactation periods, and correcting for age and for quality of the milk. Calculating the results in this way reverses the results and gives the advantage to the non-mineral group. The production on this basis was 37.3 pounds of milk daily by the mineral group and 39.8 pounds daily by the non-mineral group, or 2.5 pounds daily in favor of the non-mineral group. This is a considerable difference but not sufficient to overcome the probable error in such experiments, which in this case would require a difference of 3.55 pounds. From these results we can not say that the minerals were either beneficial or detrimental so far as milk production is concerned.

Two other comparisons were made which throw further light on the question:

Records of the original cows were kept for some time before they were placed on experiment. The production of six cows in each group for the lactation just preceding the experiment was compared with their production during their first lactation after being placed on experiment. The results of this comparison showed that both groups increased rather markedly due to better feeding, but that the non-mineral group showed a greater increase than the mineral group.

Meigs, as stated previously, showed that the effect of mineral feeding appeared during the lactation period following the feeding. Probably there was a reserve storage of minerals in the bodies of the cows which was largely used up during the first year in the case of the cows receiving no minerals. To test this result the production of five heifers in each group during their first lactation

periods was compared with their production during their second lactation periods. During the second lactations, the mineral heifers increased their production 27.9 per cent over the first, but the non-mineral heifers increased their production 30.8 per cent.

Some of these differences in favor of the non-mineral group may be due to the fact that the mineral replaced 2 per cent of the grain. If this be true the mineral was of less value for milk production than the grain replaced.

None of these differences are large enough to be really decisive; therefore, the conclusion must be that the dicalcium phosphate had no appreciable effect on milk production over the five-year period.

Dairymen should not infer from this article that mineral supplements should never be fed. Cows fed rations markedly low in minerals or very high producing cows may profit by the proper use of mineral supplements.

A more detailed discussion of this experiment will appear in a monograph bulletin, which will soon be published.

FOOT-ROT IN SHEEP

D. S. BELL

For many years sheep raisers have dreaded the troublesome affections to which the feet of sheep are liable. The exasperating and costly experiences of sheep men during the 70's, 80's, and 90's, when true foot-rot ravaged the flocks of Ohio, have been handed down to the present generation with such vivid descriptions of the devastating ailment, and the persistence with which treatment had to be applied to effect a cure, that even now any indication of lameness usually calls forth the term, "foot-rot"; a term by which all foot ailments seem to be known collectively, but incorrectly.

Fortunately for present day husbandry our ancestors worked with a persistence and painstaking care that all but rid Ohio flocks of true or contagious foot-rot. There may be isolated cases where the contagious and enzootic form of foot-rot still persists and therefore vigilance should be maintained. The form of foot-rot most generally encountered, however, is a non-contagious ailment which preventive and curative treatment can quickly banish.

There is an undeniable similarity in some respects between the contagious and non-contagious form of foot-rot; yet they exhibit some identifying differences. For the sake of clarity each form will be discussed separately.

Contagious foot-rot.—Contagious or true foot-rot in sheep is a highly infectious and contagious disease due to the deep-burrowing microorganism, *Bacillus necrophorus.* Distinct lesions are formed and a disagreeable, putrid, and unmistakable odor is present, due to the exudate from the sore. This odor is so strikingly characteristic of true foot-rot that one familiar with the disease can diagnose its presence when near to, altho not seeing, the affected animal.

Mohler and Washburn, of the Bureau of Animal Industry, United States Department of Agriculture, describe the lesions of true foot-rot as follows: "The first evidence of an attack of foot-rot to attract the attention of the shepherd is a slight lameness, which rapidly becomes more marked. Previous to this, however, there has appeared a moist area just above the horny part of the foot, and this has gradually reddened and assumed a feverish, inflamed appearance. It may first become visible either at the front or back part of the cleft, but usually the erosions make their first appearance at the heel. The inflammation rapidly penetrates beneath the horny tissue. ......There is a rapid formation of fistulous passages beneath the horny covering of the foot ...... and the result ...... is that large areas of the hoof become loosened from the sensitive tissues lying beneath. ......Should the loosened horny tissues be cut away it will be seen that the undermining process has been advanced by the micro-organism until numerous ulcerative channels have been formed which are filled with grayish purulent matter and that the encroachment upon the healthy areas is persistently and constantly being extended. ......The invasion of the necrotic processes may continue until ligaments, tendons, and even the bones are attacked; but before this final stage is reached nature will attempt to repair the damage, and for this purpose the secretion of formative elements is greatly increased, until there appears a peculiar growth ...... termed "fungoid growths", which are known to materially hasten the shedding of the horny covering of the foot."

A sheep afflicted with true foot-rot suffers acute pain upon any attempt to use the foot for locomotion and consequently spends a great deal of time lying around in secluded places. If both front feet are affected the sheep may move around on its knees searching for food to satisfy its failing appetite. If the hind feet are

involved and food is not provided, the sheep will oftentimes elect death by starvation rather than suffer the intense pain induced by walking. Even upon recovery thru medical treatment the horny part of the hoof which rapidly grows anew is likely to be long, thick, and very hard, thus making locomotion difficult.

Fig. 1.—The horny walls of the sheep's foot grow long and curve under the bottom surface (right). This horny projection should be removed so that the bottom surface presents a flat appearance (left).

Transmission of true foot-rot is by direct contact or by exposure of healthy sheep to roadways, lanes, pastures, barns, or barn lots which have been traversed by ailing animals. Moist lowlands and filthy barn lots or lanes which have held affected sheep are most ideal for the spread of the disease. Plowing, or the freezing temperatures of winter, usually render infective premises safe for subsequent use by free animals. However, the barn and barn lots must be thoroly cleaned and disinfected; too much effort can scarcely be expended in this direction. Troughs, racks, walls, floors, and water containers should each have detailed attention during the cleaning process. All resultant accumulations from the cleaning should be spread on a field to be plowed.

Non-contagious foot-rot.—This is known variously in different localities as "false foot-rot", "foot-scald", "foul-foot", "inflammation

of the cleft", etc. Several forms of this ailment may be separately recognized but for practical purposes may be discussed collectively.

Sheep which have to walk in clay soils during wet weather, thru boggy sections of a pasture, or thru filthy pools in barn lots or lanes gather an accumulation of foreign material between the toes. This lodged mass frequently hardens and sets up an irritation which is aggravated by every step. If this mass is not removed serious inflammation and lameness result. Where barn filth accompanies such mechanical injuries to the feet suppuration may follow. Such suppuration or abscess formation may progress deeply until the whole hoof is involved, and may even lead to the shedding of the horny covering. It is this form of the disease that is most devastating, and death is not uncommon in severe cases. It is in this advanced stage that false foot-rot bears a striking resemblance to contagious foot-rot, altho the unmistakable odor characterizing the latter is lacking. Since the entire flock is usually exposed to the same conditions more than one individual may be affected with false foot-rot, which often gives rise to the false opinion that a highly infectious organism is the causative factor.

TREATMENT

In cases of false foot-rot the removal of the flock from low, boggy pastures to hilly land, or dry clean pastures, together with removal of any lodged material from between the toes often checks the progress of the disease. Careful shepherds will not permit their sheep to wade thru filthy mire, since this is almost sure to give rise to foot troubles. Also, flock masters should make certain that the excess horny growth that projects from the walls and curves under the bottom surface of the foot is removed at least twice each year, or oftener if necessary. Preventive management suggested by the foregoing discussion should enable sheep owners to avoid the majority of troublesome foot ailments.

In cases of contagious foot-rot or of false foot-rot where suppuration exists, medicinal treatment must be employed. Affected sheep should be removed from the main band and placed in clean, isolated quarters, where they can be given individual attention. This consists of removing the superfluous and diseased horn with a sharp knife or pruning shears, then immersing the foot in an antiseptic solution heated to a temperature as hot as the hand can bear. A solution prepared by dissolving powdered copper sulfate crystals, in the ratio of one pound for each gallon of water,

is recommended. Highly caustic drugs, like nitric acid, Butter of Antimony, etc., should be avoided, or at least used cautiously lest they cause extensive damage to the foot. The bathing should be repeated at least every other day until recovery is complete, and, in the meantime, the affected sheep should be held in the isolation quarters away from the flock.

In occasional and mild cases of foot-rot, which are likely to appear in any flock under field conditions, the removal of the foreign material, together with an application of dry, finely-powdered copper sulfate, to the injured tissue usually brings about recovery. If the season is rainy a paste or ointment may better serve the purpose. Either of the following should give good results:

Mix together:
- 1 oz. finely-powdered copper sulfate crystals
- 1 oz. turpentine
- ½ lb. lard

or:
- Equal parts of the following with enough lard, pine tar, or vaseline to make a paste—
- Finely-powdered copper sulfate crystals
- Flowers of sulfur
- Burnt alum

Mass treatment for the entire flock is recommended where contagious foot-rot is present, or where the non-contagious form affects a large number. This can be effected by causing the sheep to walk slowly thru, or stand in, a shallow wooden trough in which has been placed the saturated and heated copper sulfate solution already mentioned, to a depth of 2 inches. The importance of having the sheep proceed slowly thru the trough, so as to have the solution penetrate to the depth of the sore, is emphasized. An attendant should be on hand to see that none of the ewes lie down in the trough, as is their wont when their feet are sore. He should also make certain that every hoof comes into the solution, since there is a tendency on the part of the sheep to "carry" the foot most severely affected. The treatment may be repeated as necessary. When the task is thoroly done, and clean quarters and uninfected pastures are provided after treatment, recovery usually follows.

The flock master should remember that many cases of foot ailment among sheep are preventable. Even tho cases of contagious foot-rot are not numerous, purchased sheep should be admitted to the flock only after their freedom from disease is assured by careful inspection, or better still by a two-week period of isolation in a distant pasture.

PALMO MIDDS AS A PARTIAL SUBSTITUTE FOR CORN FOR FATTENING CALVES

PAUL GERLAUGH

Palmo Midds, a by-product of the tinplate mills, are available in large quantities to livestock farmers in this State. In the tinplate mills middlings are used to blot palm oil from the plate. These middlings with the absorbed oil are sold as Palmo Midds. Tags attached to the feed used in the test reported here quoted a minimum analysis of 16% crude protein, 7.5% crude fat, 63% carbohydrates, and a maximum of 8.5% crude fiber. According to Henry and Morrison, No. 3 dent corn contains 7% crude protein, 63.3% carbohydrates, and 4.3% fat. Palmo Midds carry fully twice as much protein as corn, about the same amount of carbohydrates, and nearly twice as much fat.

TABLE 1.—Summary of Palmo Midds Feeding Test
Dec. 5, 1929 to May 8, 1930 (154 days)

3 steers and 4 heifers per lot

	Lot 1	Lot 2
Weight, December 5, pounds	439.4	437.6
Weight, May 8, pounds	771.0	690.4
Average daily gain, pounds	2.15	1.64
Average daily ration, pounds:		
Shelled corn	11.24	6.58
Palmo Midds	......	3.02
Protein supplement*	1.48	1.48
Corn silage	4.97	4.96
Soybean hay	1.42	1.32
Feed required per cwt. gain, pounds:		
Shelled corn	522.1	400.6
Palmo Midds	......	184.1
Protein supplement*	68.9	90.0
Corn silage	230.8	301.9
Soybean hay	66.1	80.4
Cost per cwt. gain	$11.44	$13.33
Pork credit per lot	$18.04	$ 9.76
Loss per animal, pork not credited	$ 8.85	$20.73
Loss per animal, pork credited	$ 6.27	$19.34
Returns per bu. of corn, cents	69.8	......

Prices used: Shelled corn 90¢ per bu.; Palmo Midds $32, linseed meal $58, cottonseed meal $46, corn silage $6.50, and soybean hay $16 per ton; hogs $10, and feeder calves $14 per cwt.

*Equal parts linseed meal and cottonseed meal.

Feed lot valuation, May 8, Lot 1, $11.75, Lot 2, $10.75 per cwt.

In this test Palmo Midds were used as a substitute for one third of the shelled corn in the ration of fattening calves. No attempt was made to utilize the additional amount of crude protein in the Palmo Midds ration.

The calves used were choice feeder steers and heifers raised at the Ohio Experiment Station. A variation of several months existed in their ages. Both lots were similar at the start of the test.

The two lots received, daily, the same amounts of protein supplement, corn silage, and soybean hay. Equal parts of linseed meal and cottonseed meal made up the protein supplement. The calves in Lot 1 were fed as much shelled corn as they would clean up and those in Lot 2 were given all of the mixture of shelled corn, two parts, and Palmo Midds, one part, that they would eat. The table shows a different ratio in the amount of corn and middlings eaten by Lot 2. This variation is due to the larger proportion of middlings than shelled corn in the refuse.

Palmo Midds were less palatable than shelled corn. Because of this the feed consumption of Lot 2 was lowered. Less rapid gains were obtained and a lower market valuation resulted when Palmo Midds were fed. The calves fed Palmo Midds were "looser" tho they did not "scour". Less pork credit was available when Palmo Midds were used.

When the test was completed a few of the heifers were retained at the farm for breeding purposes. The remainder were sold at Cleveland. No difference in color or quality of carcasses of the calves fed the two rations was apparent to the packer.

In figuring the results the same price per pound for both shelled corn and Palmo Midds was used.

THE CANKER DISEASE OF TOMATO

R. C. THOMAS

About 6 or 7 years ago a tomato disease was first noticed in certain greenhouses near Cleveland. At that time it was new to the state. At least no report of it could be found in our records. It is hard to believe, however, that a disease of the character of the Canker disease of tomato, more particularly one of bacterial origin, is likely to make its appearance suddenly and within one or two

seasons assume an epidemic form causing serious losses. With the introduction of any disease into a new locality there is usually a long period during which infectious material accumulates and spreads before the epidemic stage is reached. During such a period it is quite natural for a new disease to be confused with one already known to be present, especially if the symptoms are similar in some respects. It is very likely that the Canker disease of tomato was present in Ohio for some time, being confused with Fusarium or Verticillium wilts.

This tomato disease has been present a sufficiently long time for us to form some idea as to what its possibilities are and what may be expected from it. We know that it may occasion losses as serious as the Fusarium wilt; it is fully as persistent and difficult to get rid of, and is much more easily spread. Plants which become diseased in the seedling stage or before the first cluster is set, usually do not mature profitable yields and commonly nothing at all, under greenhouse conditions. Losses, therefore, naturally vary according to the stage of development of the plants when they become diseased, and according to the extent of infection. Reduction in yield may be so slight as scarcely to be appreciated; while on the other hand an entire crop may be lost. This may be the experience for not merely one season, but similar results are quite sure to follow in later plantings, if no control measures are applied.

The Canker wilt is a typical greenhouse disease. It has never been observed to cause any appreciable loss in field tomatoes in Ohio. Three years ago 50 plants were inoculated in the field, just before the first fruit cluster was set. The organism developed sufficiently to show symptoms in every plant inoculated yet the plants were not seriously handicapped. They continued to grow luxuriantly and there was slight reduction in yield when compared with disease-free plants. This test was repeated the following year with similar results. Similar tests duplicated under greenhouse conditions at the same time showed a marked contrast in results. Within a month or six weeks all inoculated plants were dead, yielding only 15 per cent of a crop compared with disease-free plants. The plants in the greenhouse grew much more rapidly and were more succulent because the temperature was higher and the moisture optimum. Under such conditions the disease became virulent, Figure 1. Basing the judgment upon such results one does not anticipate that this disease will become a major problem in field crops of tomatoes.

In this case, we are dealing with a bacterial disease, which alone is significant because bacterial diseases commonly are more difficult to control than those of fungus origin and also lend themselves to ways and means of dispersal which do not apply in the case of fungi. Likewise, control methods must be modified accordingly. These distinctions, however, must be very closely observed.

Fig. 1.—Left: Plant killed by bacterial canker six weeks after inoculation. Right: Disease-free plant

Every plant disease has its own symptoms. In some cases these are clear cut and sufficiently distinctive so that there is no difficulty in recognizing them. In other cases we are not so fortunate. In Fusarium wilt of tomato the yellowing and later wilting of the leaves as the fungus advances are very characteristic; while in the canker disease there is a wilting and drying of the leaves but no yellowing. The leaves retain their green color, wilting and drying from the tip backward, Figure 2. From this

description it would appear that the two types of wilts should not be confused. There need be no mistake in identifying these two diseases of tomato so long as there is only one present in a plant, but on the other hand when a combination of the two types of wilt occurs in the same crop, the symptoms are misleading, Figure 3. Such a situation frequently occurs. It also frequently happens that after one organism has gained entrance into a plant the way is opened for others to follow. Each follow-up organism modifies the original symptoms after its own fashion.

In the early stages of the canker disease, the internal symptoms are much the same as in Fusarium wilt; browning of the vascular bundles. Later longitudinal cavities appear and eventually the stem becomes hollow in portions or even entirely. A breakdown or dry rot of the interior tissues is the last stage of the disease.

Fig. 2.—Typical wilting and canker formation upon stem

From the economic point of view we are most concerned with the manner of spread and control of the disease. Our investigations of the past 3 or 4 years have shown that the spread may be brought about in various ways. Healthy plants will take the wilt if they are sprayed with a suspension of the bacteria. If plants are pricked with a needle carrying the organisms they very soon show typical symptoms. This fact suggests that there is a possibility that insects in passing from diseased to healthy plants may be agents in spreading the disease; yet insect transmissal need not be given very serious consideration because there are other means of spread which are far more effective. The presence of the bacteria

can be readily detected upon seed taken from fruit from diseased vines. When such seed is planted a small percentage of the plants always show infection. The fact that the organism may be spread thru the seed is extremely important. After the disease has become established other means of dispersal become more potent factors in taking up and continuing the further spread of the bacteria.

Fig. 3.—Both bacterial canker and Fusarium wilt were found in this plant

Last season 200 plants, developed from seed taken from diseased fruit, were allowed to grow in a greenhouse until about 8 inches high. They were then transferred to the field. All of the plants grew well and produced fruit. An occasional wilted leaflet was noticed during the hot, bright, sunshiny days of late summer. Otherwise growth appeared to be normal. On the other hand when special examinaion was made of the basal portion of the stems in September, 30 per cent of these plants were found to be infected with the tomato canker organism. This shows, furthermore, that it is possible for a seed crop to be developed, produce infected seed, and yet show no striking symptoms.

Healthy plants placed in soil from which a diseased tomato crop has been taken usually show the presence of the wilt in due time, and the bacteria can be isolated from such soil. We also have ample assurance that they will survive in the soil indefinitely. The disease can still be found in the houses in this section where it was first detected 6 or 7 years ago and it is known still to be present in the Grand Rapids district where it was first located some 15 to 20 years ago.

In studying this disease it appeared reasonable to assume that the bacterial wilt might also be spread in suckering the plants. In order to determine this 50 plants were first suckered in the usual way. Then, upon each wound formed by the removal of a sucker, a few drops from a pure culture of the bacterium were placed. After 4 weeks 75 per cent of the plants treated in this way had become diseased. Another series of plants were suckered after the juice from badly diseased plants had been smeared upon the fingers. Of this lot 50 per cent developed typical wilt symptoms. It is evident that the disease can be spread very rapidly during one season, by passing promiscuously from diseased to healthy plants in suckering. In this respect one is reminded of the similarity in manner of spread of bacterial wilt and the virus diseases such as mosaic.

From the brief discussion that has already been presented, it is evident that we cannot confine our attention to any one operation and say that this will control the canker disease of tomato. It is not as simple as that because there are too many factors involved. In the control of any disease it is well, first of all, to look to the plant bed, for there is no doubt that in the majority of cases the trouble begins there, especially if there is any possibility of seed transmission. Prompt removal of diseased plants is of prime importance, and the sooner they are removed the better. In this way the development of disease-producing organisms in the soil is reduced to a minimum as shown by the spread of bacterial wilt by suckering and handling of the plants. Probably there will never be a time when we can neglect to give due regard to sanitary measures. A diseased plant cannot help being a menace so long as it remains in the house, not only from the standpoint of suckering but also from the fact that the longer a diseased plant remains in place the more extended becomes the contamination of the soil.

After the disease has become widespread in a house there is only one recourse so far as is known at present, and that is soil sterilization with steam. Because of the fact that very frequently other types of wilt are also present along with the canker disease, steam sterilization will probably afford most satisfactory control. The bacterium is apparently not hard to kill since it is not known to assume a stage or form particularly resistant to heat. Killing temperatures which are adequate for Fusarium wilt or nematodes are ample for tomato canker.

The stages in the control may be summarized as follows: learn to know the disease, use only seed from disease-free plants, be on the lookout for diseased plants from the time the seedlings appear

thru the ground until the crop is harvested, and remove as soon as noticed. Soil sterilization is expensive, and if it can be delayed by giving strict attention to sanitation, thereby preventing the spread and accumulation of infectious material, so much the better.

DOUBLING OF THE FLOWERS OF STOCKS

ALEX LAURIE

The average grower of stocks in the greenhouse depends upon the percentage of doubling for his profits, since, in many localities, stocks are a drug on the market. The beauty and grace of the single stocks in comparison to the double is beside the point, and, altho our personal preferences may be toward the single varieties, we have to bow to the will of the buying public. Hence, doubles are in demand.

Some growers have claimed that they could distinguish the singles from the doubles in the early stages of plant development, but they fail to divulge their secret. As a consequence, the average grower has failed to benefit by the experience of others. Some work has been done along this line in recent years and following the line of thought that vigor of plant may have something to do with its doubling, some tests were made, the results of which are here presented for what they are worth.

About 1,000 seedlings of Beauty of Nice stocks were potted in 2½-inch pots early in the spring and later repotted into 3-inch pots. Just before being set outdoors in May, they were grouped into four sections according to their vigor; the largest and most vigorous in one, followed by those slightly smaller and less vigorous, then those of still smaller size and, finally, the smallest. We expected to secure the lowest percentage of doubles from the small plants and a rising scale as the plants became more and more vigorous. Our results justified the notion.

They were:

1. Small plants, non-vigorous—thirty-two per cent doubles.
2. Larger plants, more vigorous—forty per cent doubles.
3. Still larger plants—forty-seven per cent doubles.
4. Largest group containing most vigorous plants—sixty-one per cent doubles.

The evidence is not conclusive, but must be followed up, not only thru the selection of the largest and most vigorous plants, but possibly thru the selection of the largest and most viable seed.

These tests were duplicated by others with greenhouse-grown stocks using selected plants of each variety both for the checks and the treatments. Frequently when stocks are grown to a single stem and are planted closely in the bench the more vigorous individuals crowd out the less vigorous and a goodly proportion of doubles results.

It has also been shown that stock seed which remains viable for three years will produce a large proportion of doubles. This is undoubtedly due to the fact that the seed which is able to germinate after so long a period must be very vigorous, producing strong plants with double flowers.

The tests conducted were based on the assumption that any soil treatment which increased its vigor would result in stronger plants. To secure additional vegetative vigor liquid Urea was used as nitrogen carrier, applied once in two weeks at the dilution of one ounce to seven gallons. German and Michigan peats were also used as mulches and mixtures applied at the rate of 1/5 part of the soil by volume.

Heatham Beauty			Bismarck		
Treatment	Per cent singles	Per cent doubles	Treatment	Per cent singles	Per cent doubles
Soil (check)	52	48	Soil (check)	59.1	40.9
Soil and nitrogen	27	73	Soil and nitrogen	40	60
Soil and imported peat (mulch)	44	56	Soil and imported peat (mulch)	28	72
Soil and domestic peat (mulch)	29	71	Soil and domestic peat (mulch)	31	69
Soil and imported peat mixed	25	75	Soil and imported peat mixed	36	64
Soil and domestic peat mixed	44	56	Soil and domestic peat mixed	40	60

In another trial a highly concentrated fertilizer (17-34-17) was applied in liquid form at two-week intervals in a dilution of one ounce to two gallons of water.

The table indicates the results.

These tests are fairly conclusive and indicate that the tendency to doubling in stocks is dependent upon vigor in the plant. Stimulation of vegetative vigor by means of nutrient additions is a means to that end. Ordinarily vegetative vigor may result in diminished reproductive activity and consequent reduction of flowering, but apparently in the case of stocks with their natural

tendency to doubling from seed of single kinds, the stimulation results in the transformation of reproductive parts into increased petalage—doubling.

Branching Rose			
Check		17-34-17	
Doubles	Singles	Singles	Doubles
50	50	33	67
Empress Aug. Victoria			
Check		17-34-17	
Doubles	Singles	Singles	Doubles
54	46	30	70
Heatham Beauty			
Check		17-34-17	
Doubles	Singles	Singles	Doubles
53	47	42	58

CORN PLANTER WORK CONTINUES

C. O. REED

Tests on the placement of fertilizer in hill applications to corn are being continued this year. This work was started last season as a cooperative project between the Departments of Agronomy and Agricultural Engineering; the former looking after the agronomic features, and the latter department caring for the mechanical phases of the problem.

Six common makes of corn planters are being used under actual field conditions to place hill applications at rates of 100, 200, 300, and 400 pounds per acre. The purpose of the work is to determine the relative efficiency of different methods of placement, rather than to compare directly the different makes of planters. Incidentally, information is being gained of vast importance to manufacturers who are interested in the improvement of fertilizer attachments. This year the Department of Agricultural Engineering hopes to try out an attachment of its own design. In this

device an attempt is made to place the fertilizer close enough to the seed to gain maximum effectiveness with minimum loss in germination.

The Department of Agricultural Engineering has perfected a system of determining the exact placement of the fertilizing material in respect to the seed, both in the vertical and horizontal planes. This system, called the plane method of reading, is being used in the field this spring instead of in the laboratory. In addition to this new feature in the work, the Department of Agronomy will introduce some unique schemes of its own to discover new fundamentals in this important problem of fertilizer placement.

Obviously, data gained by only one season's work are not dependable enough to justify publication; results obtained this season may contradict previous findings. In justice to all parties concerned, the results cannot be made public until the testing has run long enough to minimize the effects of peculiar or abnormal seasons. In the meantime, development work will continue with all possible haste. The development of improved ways and means for fertilizer placement is really the most important objective.

THE TREND OF AGRICULTURAL PRODUCTION IN OHIO SINCE 1910

V. R. WERTZ

In a previous issue of this bulletin there appeared an article entitled "Trend in Sales and Prices of Ohio Farm Products Since 1910". In this article it was pointed out that the quantity of goods sold from Ohio farms—grains, meat animals, dairy products, etc.—had increased since pre-war days from 10 to 14 per cent.

The quantity of goods produced, whether sold or consumed on farms, has likewise increased since the pre-war period 1910-14, but less rapidly than the sales of these products.

Indices of the physical volume of production and sales of Ohio farm products are given in the following table.

The index of production represents the amount of agricultural products produced on Ohio farms since 1910. This index was determined by substituting the estimated quantities of crops, livestock, and livestock products produced on Ohio farms, and estimated farm prices of these products in Fisher's "ideal"

formula.[1] The base period was 1910-14. The index of physical volume of sales of Ohio farm products given in the second column of the accompanying table was calculated on the same basis as that of production.

TABLE 1.—Ohio Farm Products: Indices of the Physical Volume of Production and Sales, 1910-28

Year	Production	Sales	Year	Production	Sales
1910	105	102	1920	115	120
1911	98	102	1921	100	107
1912	107	94	1922	107	114
1913	94	98	1923	111	114
1914	96	103	1924	104	116
Average 1910–14	**100**	**100**	**Average 1920–24**	**107**	**114**
1915	108	110	1925	108	106
1916	97	106	1926	105	120
1917	110	106	1927	104	115
1918	111	123	1928	107	100
1919	115	135			
Average 1915–19	**108**	**116**	**Average 1925–28**	**106**	**110**

A year by year comparison of these two series, production and sales, is less significant than a compilation covering a period of several years, since the index of sales refers each year to products sold in that calendar year; whereas the index of production is based upon the goods produced in that calendar year, but not all sold until later.

From 1910-14 to 1915-19 production increased from 100 to 108, while sales increased from 100 to 116; from 1920-24 production averaged 107 and sales 114; and from 1925-28 production averaged 106 and sales 110.

These figures indicate that our farmers are selling a larger portion of the goods which they produce than in pre-war days. This probably also means that Ohio farmers are buying more from the city.

[1] $$\sqrt{\frac{Ep_1 \; q_0}{Ep_0 \; q_0} \times \frac{Ep_1 \; q_1}{Ep_0 \; q_1}}$$

OHIO FARM LAND AREA AND TOTAL PRODUCTION

J. I. FALCONER

In another article in the Bimonthly Bulletin it is pointed out that the area of land in farms in Ohio has been decreasing since 1910. It does not follow, however, that the total volume of agricultural production in the state has been decreasing; the contrary seems to be the fact.

Figures as to the total area of land in farms in the state are not available for a date later than 1925. However, the census of that year shows that there had been an 8% decrease in area in farms since 1910. Data compiled by Mr. Wertz, however, show that for the period since 1920 the volume of production has averaged 7% above that of the period around 1910. This would indicate that from 1910 to 1925 we had an 8% decrease in farm area but a 7% increase in the volume of production. In the main, the acres which are going out of production are in the poorer land areas of the state; while the increase in volume of production is coming from the more productive areas. More intensive crops and types of livestock have been substituted for the less intensive types; while better crop yields and increased efficiency in our livestock, thru better feeding, breeding, and management have been the means of increasing production.

Year	Land in farms		Volume of production	
	Acres	Index	Year	Index
1910	24,105,708	100	1910-14	100
1920	23,515,888	98	1915-19	108
1925	22,219,248	92	1920-24	107
			1925-28	106

It is estimated that there were 1,239,451 people living on Ohio farms in 1910 and 1,031,718 people in 1925, a decrease in numbers of 17%; this would indicate that 17% less people are producing a 7% greater volume of products, or a 29% increase in output per person. This greater output per person has been due mainly to the above mentioned reasons as well as to the adoption of labor saving methods and practices.

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

Farm real estate dealers are reporting a more active market for farm land this spring than has been true for some time past. The March 1930 index of Ohio farm land values, however, shows a decline of three points from 1929, and thereby places reported Ohio land values at ten per cent less than those of 1913. If 1913 values represent 100, the values of 1920 would be 159 and those of 1930 not over 90.

The decline in all commodity prices which started in July 1929 continued thru May 1930 and has now been in progress for about one year; an important factor in this decline has been the fall in the prices of farm products. For the first four months of 1930 the income to Ohio farms from sales of products has been less than that of 1929.

Trend of Prices and Wages, 1910-1914=100

	Wholesale prices all commodities U. S.	Weekly earnings N. Y. state factory workers	Prices paid by farmers for commodities bought U. S.	Farm products' prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm products' prices	Ohio cash income from sales
1913........	102	....	100	100	104	100	105	100
1914.......	100	100	101	102	102	102	105	107
1915........	103	101	106	100	103	107	106	110
1916........	130	114	123	117	113	113	121	120
1917........	181	129	150	176	140	119	182	197
1918........	198	160	178	100	175	131	203	243
1919........	210	185	205	209	204	135	218	265
1920........	230	222	206	205	236	159	212	242
1921...	150	103	156	116	164	134	132	136
1922........	152	297	152	125	145	124	127	135
1923........	156	214	153	135	166	122	134	148
1924........	152	218	154	134	165	118	133	150
1925........	161	223	159	146	165	110	159	164
1926........	154	229	156	136	170	105	155	176
1927........	149	231	154	131	173	99	147	163
1928........	153	232	156	139	169	96	154	147
1929........	151	236	155	138	169	94	151	154
1929								
January...	152	234	156	133	166	....	144	145
February..	151	236	156	136	....	....	149	137
March	153	239	156	140	....	94	155	143
April......	152	237	155	138	163	....	150	148
May.......	150	236	155	136	....	....	152	149
June.......	151	236	155	135	....	....	153	155
July	154	235	155	140	172	....	157	174
August....	153	237	155	143	....	....	159	163
September.	153	240	155	141	....	....	153	160
October....	151	237	154	140	174	....	151	166
November .	148	233	154	136	....	....	149	159
December..	148	234	154	135	....	....	147	146
1930								
January...	148	235	154	134	158	....	141	152
February..	146	231	153	131	....	....	137	134
March	144	235	153	126	158	90	132	131
April......	144	....	....	....	....	....	136	133

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Ohio Agricultural Experiment Station

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WOOSTER, OHIO, U. S. A.

Free Bulletin

C. G. Williams

Director

Administration building at the Ohio Agricultural Experiment Statio

PROTEIN CONCENTRATES FOR YEARLING STEERS

PAUL GERLAUGH AND PAUL HACKETT[1]

Equal amounts, by weight, of linseed meal, cottonseed meal, whole Manchu soybeans, and a mixture of equal parts of the three were compared as sources of protein for yearling steers.

Four hundred head of steers were divided into four lots of one hundred head each. The cattle were divided by the so-called "gate cut" method. It was agreed by those who saw the cattle at the start of the test that no apparent difference existed between the quality of the cattle in the various lots.

Ground ear corn, corn silage, and legume hay, together with one of the protein supplements, made up the ration. Sweet corn cannery silage was used from the start of the test, December 3, until February 9. Field corn silage was used from February 9 to May 15, when all lots were again placed on the cannery silage.

The same amount by weight of each of the protein carriers was fed to each lot of cattle. From December 3 to December 16 one pound daily per steer was fed. This amount was increased to one and a half pounds daily from December 16 to January 29, when the amount was increased to two pounds daily on which level it remained until the conclusion of the test. The same amount of corn was fed to each lot until near the close of the test when it was necessary to reduce the amount fed to Lot 3.

The linseed meal used was a standard brand carrying 34% protein; the cottonseed meal carried tags of a standard brand guaranteeing 41% protein; the soybeans were home-grown, of the Manchu variety. The quality of most of the beans was good. Due to the wet weather of the fall season some of the beans were lowered in quality, though not sufficiently to decrease noticeably their palatability.

Lot 4, fed the mixture of protein supplements, showed the keenest appetites throughout the test. As the test neared the close it was felt that Lot 4 would consume more corn; neither of the other lots indicated that their corn allowance could be increased. There was no apparent difference between any of the lots in date of shedding the hair; neither was there any trouble in any lot of cattle going "off feed."

[1]This test was conducted at Oakland Farm, owned by Thomas Johnson and managed by Paul Hackett. The Experiment Station is indebted to Mr. Johnson and Mr. Hackett for their excellent cooperation.

The prices used on linseed meal and cottonseed meal were car-lot prices at the start of the test. The price used on soybeans was their market value, based on an oil-extracting company's price. It should be recognized that these prices fluctuate from season to season, and also in various communities during the same season.

No market valuation was placed on the lots at the conclusion of the test. Men who viewed the cattle May 29, at the Field Day, expressed the opinion that Lot 4 showed more condition than any other lot. A cattle salesman from one of the terminal markets stated that on a strong market Lots 4 and 2 might command a higher selling price than the other two lots.

TABLE 1.—Protein Concentrates for Yearling Steers

December 3, 1929 to May 26, 1930 (174 days)	Lot 1 Linseed meal	Lot 2 Cottonseed meal	Lot 3 Whole soybeans	Lot 4 Mixture*
Steers per lot, December 3	101	100	100	100
Initial weight per steer, lb.	660	663	686	673
Final weight per steer, lb.	1032	1053	1056	1061
Average daily gain, lb	**2.14**	**2.21**	**2.13**	**2.23**
Average daily ration:				
Ground ear corn, lb	15.8	15.8	15.8	15.9
Protein concentrate, lb	1.8	1.8	1.8	1.8
Silage, lb	14	14	14	14
Legume hay, lb	2.5	2.5	2.5	2.5
Feed required per cwt. gain:				
Ground ear corn, lb	738	715	740	710
Protein concentrate, lb	84	82	85	81
Silage, lb	648	628	656	628
Legume hay, lb	119	115	119	114
Cost of 100 lb. gain	**$ 11.86**	**$ 11.17**	**$ 11.57**	**$ 11.21**

*Equal parts linseed meal, cottonseed meal, and whole soybeans.
Ground corn 75¢ a bu., soybeans $1.35 a bu.; linseed meal $53, cottonseed meal $45, sweet corn cannery silage $2.50, field corn silage $5, and hay $10 a ton.
A steer died in Lot 1, January 8; in Lot 2, April 12; in Lot 4, May 2.
Sweet corn cannery silage used December 3 to February 9, and from May 15 to close of test.

After the conclusion of the feeding test 240 of the best cattle were selected from the four lots and sold for slaughter in New York. Under these conditions carcass information was not obtainable.

RETURNS PER ACRE IN CATTLE FEEDING[1]. PART II

PAUL GERLAUGH AND H. W. ROGERS

The results of Part I of this experiment, conducted during the season of 1928-29, were reported in Ohio Agricultural Experiment Station Bimonthly Bulletin 139. Part I compared returns from an

[1]Madison County Experiment Farm.

acre of corn fed as silage with returns from an acre of similar corn, cut, shocked, husked, cribbed, and fed as shelled corn and stover. An acre of corn fed as silage gave noticeably greater returns in pounds of beef and in dollars than did a similar area fed as shelled corn and stover. Cottonseed meal and mixed hay were fed to both lots of cattle.

In the second test, herein reported, one lot of cattle was fed corn in the form of silage, the same as the year previously, but the second lot was fed a combination of silage and shelled corn. Each steer in the second lot was fed half as much silage as each steer in Lot I. In addition to the half feed of silage, shelled corn was fed in such quantities as the cattle cared for.

Ten acres of corn were placed in the silo and five acres of corn from the same field were shocked, husked, and cribbed. The two areas had been so alternated as to make them comparable in both quantity and quality of corn. The corn that was shocked and cribbed was abnormally high in moisture, due to rainy weather during the fall and winter seasons. Moisture content determinations of the shelled corn showed an average of 23.5%. The high moisture content was responsible for the development of considerable mold on some of the corn. The quality of the shelled corn which was fed was not lowered sufficiently to lessen its palatability, though the quantity consumed daily was probably higher than it would have been had the moisture content been normal for this season of the year.

Yearling steers, grading good, and costing $9.50 per cwt. at St. Paul, were used in the test. Shorthorn and Hereford blood predominated in the cattle. One steer died prior to the start of the test; charging the loss of this steer to those remaining made the cost of the cattle at the start of the test $10.50 per cwt.

Fourteen head were placed in Lot 1 and ten head in Lot 2. Each steer in the two lots received 2 pounds of cottonseed meal daily and as much mixed clover and timothy hay as it wanted. The stover from which the corn was husked was fed to Lot 2.

From the accompanying table it will be noticed that the steers in Lot 1 ate nearly fifty pounds of silage per day and gained 2.1 pounds daily, for a feeding period of 177 days.

Lot 2, which was fed silage and shelled corn, outgained the silage-fed cattle four tenths of a pound daily.

A market valuation was placed on the cattle a week prior to the conclusion of the test. Lot 1 was valued at $10.60 in the lot and Lot 2 at $11.25. The margin between initial and final feed lot

valuations was 10 cents per cwt. in Lot 1, and 75 cents per cwt. in Lot 2. These margins would probably be considered less than normal.

TABLE 1.—Summary Madison County Cattle Feeding Test, 1929-30

Yearling steers fed 177 days November 13, 1929 to May 9, 1930	Lot 1 Corn silage Cottonseed meal Mixed hay	Lot 2 Shelled corn Corn silage Cottonseed meal Mixed hay Corn stove
Number steers per lot	14	10
Cost of cattle in feed lot per cwt	$10.50	$10.50
Average weight, November 13, lb.	662	662
Average weight, May 9, lb.	1036	1107
Average daily gain, lb.	2.11	2.51
Average daily ration:		
Shelled corn, lb.	....	11.9
Corn silage, lb.	49.4	24.9
Cottonseed meal, lb.	1.96	1.96
Mixed hay, lb.	2.78	2.06
Corn stover, lb.	....	7.68
Feed required for 100 pounds gain:		
Shelled corn, lb.	....	475
Corn silage, lb.	2339	989
Cottonseed meal, lb.	92.9	78.0
Mixed hay, lb.	131.5	81.9
Corn stover, lb.	....	304.9
Steer days per acre corn *	337	205
Acres corn to feed one steer 177 days	.525	.864
Beef per acre of corn fed, lb.	712	515
Pork credit per acre of corn fed, lb.	28	66
Total beef and pork per acre of corn fed	740	581
Cost of 100 pounds gain	$ 8.01	$10.51
Market appraisal, feed lot weights	$10.60	$11.25
Profit per steer, pork not included	$10.34	$ 8.18
Pork credit per steer	$ 1.45	$ 5.51
Profit per steer, pork included	$11.79	$13.69
Returns per acre of corn fed	$56.66	$57.06

*Yields per acre: 8.8 tons silage put into silo—8.3 tons fed to steers. 63 bushels corn fed.

Feed prices: Shelled corn 65¢ a bu.; silage $4.50, stover $4, hay $10. cottonseed meal $45 a ton; hogs $10 cwt.

Market valuation placed on cattle May 1 by Harry Forman, Pittsburgh, Fred Hollmer, Cleveland, and C. R. Martin, Buffalo.

Lot 1 returned 712 pounds of beef and 28 pounds of pork per acre of corn; while an acre of corn fed to Lot 2 returned 515 pounds of beef and 66 pounds of pork. An acre of corn fed as silage returned $56.66 as compared with a return of $57.06 from a similar acre fed as silage and shelled corn.

At the conclusion of the test the cattle were shipped to the Pittsburgh market. The identity of two of the steers from Lot 2 was lost, which made uncertain the separation of the cattle into their respective lots at the market. As sorted at the market, the two lots sold within 50 cents per cwt. of each other. Both lots were sold to the same butcher, but were not killed at the same time, so that the killing data were not comparable. The butcher who killed the cattle stated that both lots yielded desirable carcasses in color and firmness.

The test indicates that an acre of corn fed as silage returns more beef than if fed as silage and shelled corn. The increased efficiency of the silage ration was lost in the final feed lot valuation, due to a higher market valuation of the silage and corn-fed cattle. The cattle fed a combination of silage and corn made noticeably greater returns than did the cattle fed corn alone in the previous test.

The two years of the test would indicate that silage is an important part of the ration of fattening steers. This test would indicate that the cattle feeder can put as much of his corn crop into the silo as possible. The season of marketing, the market on which the cattle are sold, and the cost of harvesting the corn crop by the two methods are all factors to be considered by the feeder in determining the practice he can best follow.

THE NEW LAYING HOUSE AT THE STATION'S POULTRY PLANT

D. C. KENNARD AND V. D. CHAMBERLIN

The new laying house recently completed at the Station's poultry plant was designed to embody some of the newer developments in poultry housing. The many poultry keepers visiting the poultry plant have shown much interest in the house and a considerable number have expressed their desire for plans; hence the purpose of this article is to meet such requests.

SPECIAL FEATURES

Some of the special features are the type of windows and their arrangement, east front, insulation, hot water heating, and built-up roofing.

The windows and their arrangement.—The windows are designed to admit direct sunlight to best advantage and to control ventilation conveniently. Both sashes drop into pockets below, where they are protected against breakage and the weather, and at the same time the entire window space is left open for direct sunlight and ventilation. The windows operate in metal guides by means of single exposed sash weights inside. The metal rain table is placed next to the bottom sill and extends to the outside thru a half-inch opening in the siding. The window space is inclosed by

1-inch mesh netting placed on removable frames inside of the windows which also protects the glass from sash weights and prevents the birds from roosting on the window sills.

East front.—It is traditional to face poultry houses to the south; either exposure has its advantages and disadvantages. More sunlight may be secured during December and January from the southern exposure but the eastern exposure has the advantage in this respect during the other 10 months of the year, when the morning sunlight bathes the entire floor space. Chickens seem instinctively to enjoy basking in the morning and evening sunlight. During the summer the sun's rays are so nearly vertical that little sunlight enters the poultry house facing south, and when the sun does not rise so high and the rays can enter the south front during December and January, the weather in most sections usually

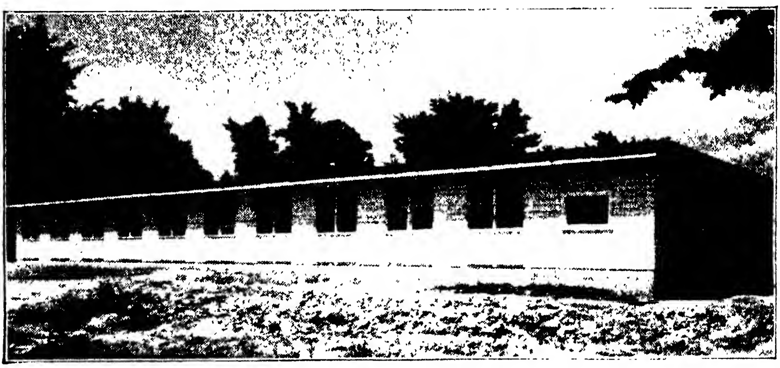


Fig. 1.—The new laying house at the Ohio Experiment Station to be used for conducting tests concerning egg production and hatchability

does not permit opening the windows to admit the unfiltered sunlight and furthermore at this time the ultra-violet light in direct sunlight is at its minimum. A house faced south with a shed roof sloped to the north is less exposed to the heat of the sun than when it faces east, but this advantage is more than offset by the disadvantage of the south front in that it is more exposed to prevailing wind, storms, and rain than the house which faces east. These points for and against both exposures are cited as suggestions for consideration when it comes to locating the laying or brooding house, many of which are now being faced to the east for the reasons here mentioned.

Insulation.—A poultry house is no longer considered finished unless it is adequately insulated against the temperature extremes

of both winter and summer. By insulation is meant the lining or sheathing applied on the inside of the studding and beneath the rafters or ceiling supports. Either insulating board or matched, well-cured lumber may be used. The effectiveness of insulation against low temperatures was indicated by daily temperatures recorded at the Station's poultry plant during the winter of 1929-30. When the outside temperature ranged from 10° above to 8° below zero with an average of 4° above, the range in the insulated laying house was from 39° to 18° and averaged 24° above

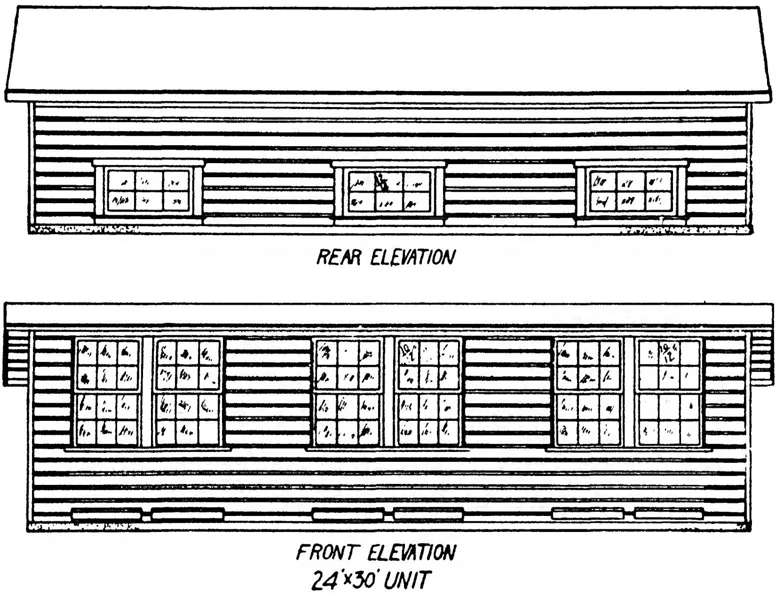


Fig. 2.—Front and rear elevations. The same plans may be used for a house any length, either 20 or 24 feet wide

zero; whereas in the non-insulated house the temperature ranged from 28° above to 2° below zero with an average of 14° above. This difference in favor of the insulated house is deserving of careful consideration. It might, in some cases, mean the prevention of a considerable loss of egg production even to the extent that such loss in one year might approximate the cost of insulation. In order to realize fully the benefits of insulation during severely cold weather it is necessary to close all windows and openings so as to conserve the heat as much as possible, regardless of ventilation or dampness.

Hot water for heating.—The principal advantage of heat in the laying house appears to be for control of dampness and to keep the temperature from going much below the freezing point. The

heating pipes in this case are placed next to the rear wall below droppings boards, which are placed 8 inches away from the wall to permit the heat to rise to the ceiling and go forward to the front of the house where the warm air becomes cooled, settles to the floor, and returns across the floor to the rear where it again becomes heated, rises to the ceiling, and continues its circulation. In this way the heated air circulates to all parts of the house and takes up excess dampness from the litter. The front ventilator or windows are regulated to provide the desired ventilation. The amount of heat needed will depend upon the type of construction and the insulation; a comparatively small amount of heat will serve the purpose in a well built and properly insulated house.

Fig. 3.—A demonstration of how to apply a built-up roof to a group of visiting poultrymen by poultry specialists of the Ohio Experiment Station on Poultry Day, June 19, 1930.

Built-up roofing.—This type of roofing is well known for its special merits when used on large and more permanent buildings which have low pitched roofs, but the use of built-up roofing on poultry houses is somewhat of an innovation.

The ideal roof for a poultry house would be one without seams or exposed nails, simple and economical to apply, proof against wind, durable with a minimum amount of care and expense for maintenance, and, most important of all, it would effectively turn all water. It appears that the built-up roof more nearly meets these requirements than any other kind which would be practicable for poultry houses. A variety of methods and materials may be employed; however, the procedure followed at the Station's poultry plant, where more than 6000 square feet have been constructed, will be adhered to for the most part.

Materials and equipment.—The materials used were slater's felt paper—commonly called tar paper—and crude asphaltum. However, one- or two-ply roofing paper and prepared liquid asphaltum may be used. The equipment consisted of a kettle for heating the crude asphaltum, a thermometer for checking the temperature, and a hard cord mop with hard, twisted cords about one-fourth inch in diameter for applying the hot asphaltum. Mops made of soft cords or strings are not suitable. When the prepared liquid asphaltum is used it may be applied by a special roof-paint brush which is the only piece of equipment required.

Application.—Before applying the slater's felt paper a strip of good quality, heavy, smooth roll roofing 12 inches wide was nailed in place to cover the lower or drip edge of the roof and likewise over the end edges. The slater's felt was then pasted on top of this when it was applied lengthwise of roof beginning at the eaves. The paper was lapped three inches at the seams. When applying a new roof to wood sheathing the hot asphaltum is not applied to the whole surface, but streaked or spattered over about half the surface in such a way as to form many and frequent contacts for holding the paper to the sheathing. The purpose of covering only a portion of the surface of the sheathing with the hot asphaltum is to make the roofing less subject to the strain or buckling due to contraction and expansion owing to changes of temperature.

In laying the paper the hot asphaltum is first applied at one end of the roof or over a small area where it is desired to start. Then the paper is placed in the proper position on the freshly applied hot asphaltum and as the hot asphaltum is streaked or spattered on the sheathing the paper is unrolled to cover it while hot so as to get a strong attachment. After the first layer of paper is completed the same procedure is again repeated with a second covering except in this case the entire surface of the first layer of paper is covered with the hot asphaltum as the second layer is applied. The seams or laps of the second layer should go about midway between those of the first layer. After the second layer is completed it is finished off with another coating of hot asphaltum or a suitable roof coating which covers the entire surface of the completed roof.

In many instances it may be preferable to apply the slater's felt or light weight roofing paper by means of a prepared liquid asphaltum instead of crude asphaltum. The liquid product can be secured in small quantities and can be applied directly without heat, and as it sets more slowly it is more convenient to use than hot

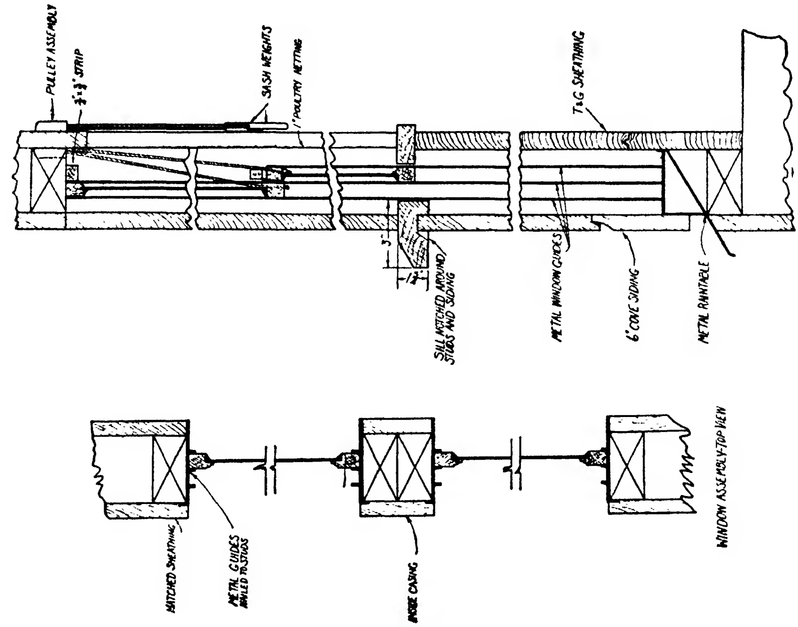


Fig. 4.—Details of window and pulley assembly. By this plan the sashes are protected while the entire space above is open for direct sunlight

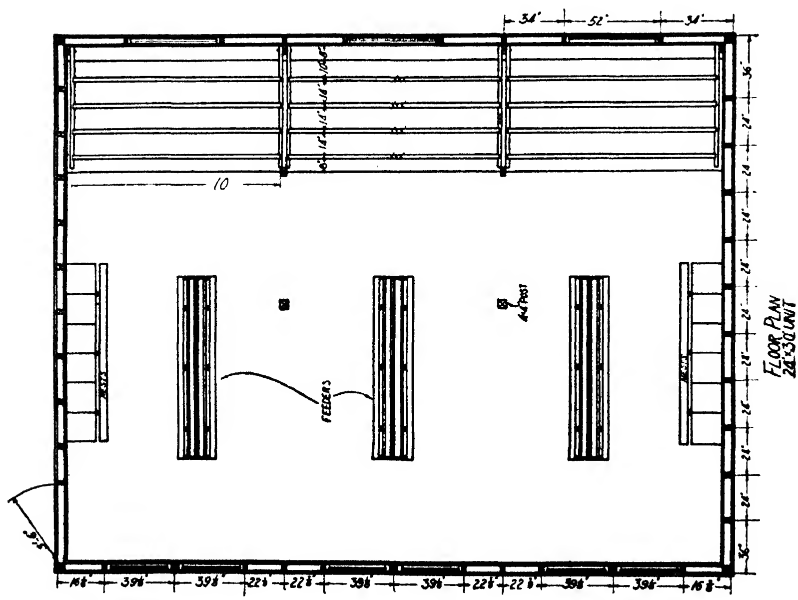


Fig. 5.—Floor plan showing location of droppings boards, feeders, and nests

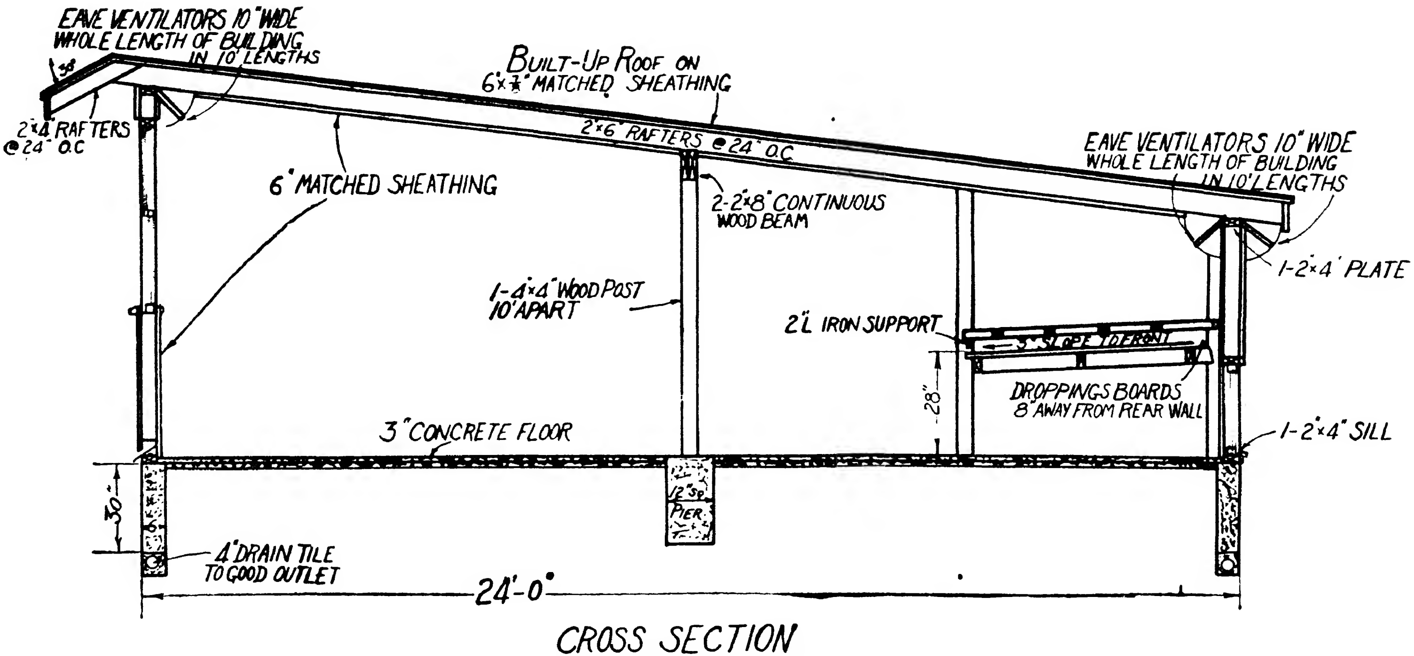
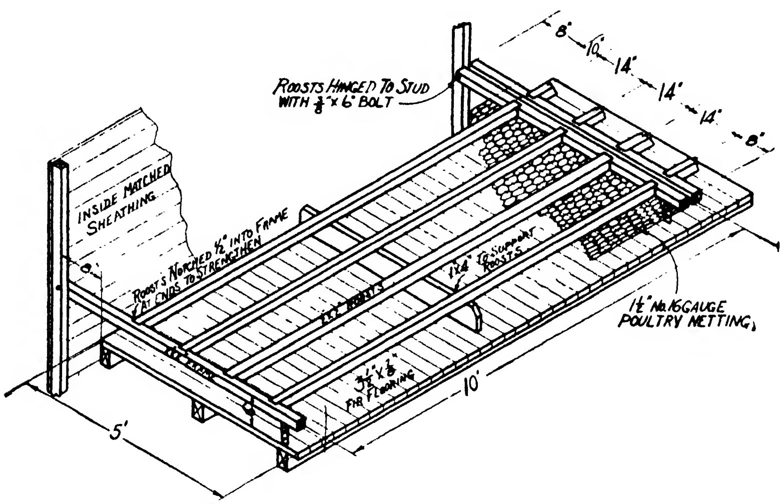


Fig. 6.—Cross section. A house 24′ wide takes studs 8′ long in front and 5′ long in rear. For a 20′ house the front studs are 7′ 6″. The droppings boards in a house 24′ wide are 6′ instead of 5′ wide to serve five roosts instead of four as indicated

asphaltum. The prepared liquid asphaltum, being prepared from crude asphaltum by the addition of semi-drying oils and adhesive materials, remains more plastic for a much longer time so that the roofing is less subject to the strain for contraction and expansion due to changes of temperature. Owing to the plastic properties of the prepared liquid asphaltum, it withstands the heat of the sun and weathering effects to better advantage than the crude product which has more of a tendency to become brittle and check, especially if it was overheated when it was applied. To avoid driving off its more volatile materials, the crude asphaltum should be kept at a temperature of 130° to 140° F. only as long as necessary before applying.



CROSS SECTION THRU ROOSTS & DROPPINGS BOARDS

Fig. 7.—Plans of droppings boards and roosts. The 2 x 4 inch stringers beneath the boards may be made continuous and held in place by cross supports each 10 feet or made as movable table supported by four legs.[1]

For maintenance the roof may be given a coating or roofing paint when its condition so indicates, or another layer of slater's felt may be applied and finished off with a top coating of hot asphaltum or roofing paint.

[1]Since the house at the Station is used for conducting tests with comparatively small groups of layers, an alley way 4 feet wide at front (not shown in the drawings) was provided. This reduced the width to 20 feet for the layers. Hence the plans for roosts and nests are the same as for a house 20 feet wide. For practical purposes the entire width of 24 feet would be available for the layers which would call for the droppings boards to be in 6' x 10' sections so as to serve for 5 roosts. This will call for a slight change in the bill of of material as indicated under that heading. Since each 24' x 30' compartment would then accommodate 200 to 240 hens of the lighter breeds, three tiers of 9 or 10 nests each at both ends of the pen would be needed.

The cost of a built-up roof.—The cost is much the same for a built-up roof as for a good quality of roll roofing. The crude asphaltum may usually be obtained for about $40 a ton. A drum containing 500 pounds will serve for about 8 squares of roofing which would cost between $1.00 and $1.25 a square of 100 square feet. The slater's felt or tar paper usually sells for about $1.00 a roll of 500 square feet or about $.25 a square including the laps, making the material cost a total of $1.25 to $1.50 a square. Since no roofing nails need be used except around edges of the roof, the time and labor for applying a built-up roof may be no more or even less than that required for roll roofing.

Repairing old roofs.—The principles of construction of a built-up roof have a valuable application for the repair of old roofs which are comparatively flat. The first procedure is to drive down all nails that may be protruding above the surface and remove any loose nails. Then it is essential to make sure that the old roof is securely attached to the sheathing. Any decayed sheathing should be replaced. Objectionable wrinkles can be removed from old roofing by slitting the wrinkle lengthwise with a knife so it can be nailed flat against the sheathing.

Where the wind has a tendency to get thru the sheathing and raise the old roofing between the seams where it is not attached, the roofing can be cut in center lengthwise between the seams so it can be opened to apply hot asphaltum or the liquid asphaltum to hold it securely to the sheathing, or the same object can be accomplished by a liberal use of roofing nails. After the old roof is prepared for the new coating the next procedure is to apply the hot asphaltum or the prepared liquid asphaltum and the slater's felt in the same manner as previously described for applying a new built-up roof. One or two layers of paper may be applied according to the condition of the roof. In applying the first layer of paper to an old roof the entire surface of the old roof is covered with the hot asphaltum or asphaltum paint so as to make a continuous adherence of the new paper to the old roofing.

BILL OF MATERIAL FOR 24′ by 30′ NEW LAYING HOUSE

CONCRETE

Foundation and post footing (5½ cubic yards, 1:2:4 mixture)		
Portland cement	30	sacks
Sand	2	yards
Stone	4	yards
Floor (7 cubic yards, 1:2:4 mixture)		
Portland cement	35	sacks
Sand	2½	yards
Stone	5	yards

Top finish (¾ yard, 1:2 mixture)

Portland cement	9	sacks
Sand	1	yard

LUMBER

2 pieces 2″ x 4″, 12 ft. long, sills.
6 " 2″ x 4″, 10 ft. long, sills.
6 " 2″ x 8″, 10 ft. long, purlin.
1 " 4″ x 4″, 14 ft. long, purlin posts.
2 " 2″ x 4″, 12 ft. long, plates.
6 " 2″ x 4″, 10 ft. long, plates.
12 " 2″ x 4″, 5 ft. long, rear studs.
18 " 2″ x 4″, 8 ft. long, front studs.
10 " 2″ x 4″, 14 ft. long, end studs.
3 " 2″ x 4″, 12 ft. long, framing front windows.
3 " 2″ x 4″, 8 ft. long, framing rear windows.
2 " 2″ x 4″, 4 ft. long, framing door.
36 " 2″ x 6″, 14 ft. long, rafters (2′ o. c.).
18 " 2″ x 4″, 2 ft. long, front roof projection rafters.
2 " 2″ x 4″, 12 ft. long, posts for supporting droppings boards stringers.
9 " 2″ x 4″, 10 ft. long, supports for droppings boards.
4 " 2″ x 4″, 6 ft. long, rest on wall for droppings boards.
12 " 2″ x 2″, 10 ft. long, roosts; spruce—15 roosts for house 24′ wide.
6 " 2″ x 2″, 6 ft. long, frame for roosts—7′ long for house 24′ wide.
3 " 1″ x 4″, 5 ft. long, roost supports.
38′ 4″ x ⅞″, 10 ft. lengths, fir flooring—12′ lengths for house 24′ wide.
750′ B. M. 6″ Cove siding.
1000′ B. M. 6″ matched sheathing roof covering.
1750′ B. M. 6″ matched sheathing, lining under rafters, sides and ends.
6 pieces 1″ x 10″, 10 ft. long, spruce No. 1 common, ventilators.
11 " 1″ x 4″, 10 ft. long, spruce No. 1 common, facing.
4 " 1″ x 4″, 8 ft. long, spruce No. 1 common, corner boards.
2 " 1″ x 4″, 10 ft. long, spruce No. 1 common, corner boards.
6 " 1″ x 4″, 10 ft. long, spruce No. 1 common, frieze gable.
1 door frame 3′ 6″ x 6′, rabbited for 1-⅝″ door.
1 door frame 18″ x 14″ jam 1″ x 4″ casing 1″ x 4″.
1 door 3′ 6″ x 6′ x 1-⅝″ white pine, paneled.
12 sashes 10″ x 12″, 6-light glazed—1-⅛″.
3 sashes 12″ x 14″, 6-light glazed—1⅜″.

HARDWARE, ROOFING, ETC.

4 rolls slater's felt, 500 square feet per roll.
500 lb. crude petroleum asphalt.
40 linear ft. 1″ poultry mesh 3 ft. wide—window openings.
30 linear ft. 1½″ mesh, No. 16 gauge wire, 4′ 6″ wide, under roosts.
18 extra heavy 3″ strap hinges—rear ventilators.
3—10″ strap hinges—entrance doors.
1 door latch D handle.
12—2″ iron door buttons—ventilators.
20 lb. 6d nails, 20 lb. 8d nails, 20 lb. 10d nails, 4 lb. 16d nails, 20 lb. 20d nails, and 4 lb. 30d nails.
2 lb. poultry netting staples.
24—½″ x 6″ bolts with nuts and washers—holding sills to concrete foundation.
4—⅜″ x 6″ bolts with nuts and washers—support droppings boards.
Metal window guides, pulleys, sash cord, weights for front windows.

GETTING WINTER EGGS FROM HENS

D. C. KENNARD AND V. D. CHAMBERLIN

Getting winter eggs from hens may no longer be considered like trying to get "blood from a turnip". By special feeding and management hens can be made to lay comparably to pullets from November to March according to results being secured by some poultry keepers and by tests conducted by the Ohio Experiment Station during the winter of 1929-30. This accomplishment offers promising and valuable opportunities for many poultrymen. From point of economy of winter egg production pullets and hens show some interesting contrasts. In the first place a select pullet, November 1, is usually valued around $1.50 because of her potential production of winter eggs; whereas a select hen of similar breeding could usually be secured for 75 cents. The value of a pullet becomes that of a hen by March 1, and this 75-cent depreciation must be charged against her winter eggs; while the hen goes thru the winter without depreciation. In fact, hens will usually command a better price in the spring. This increased value of the hens in the spring should in many instances take care of their cost of feeding while they are out of production during the fall molt and reconditioning period. This would leave the 75-cent depreciation of the pullet to the credit of the hen, which would require that the pullet lay about two dozen more winter eggs, considering the smaller size of its eggs, than the hen, to break even with the hen by March 1. Obviously the odds are in favor of the select hen. Hens laying winter eggs have a further advantage over pullets in that they are less subject to colds, roup, bronchitis and pox, and certain other diseases. Tuberculosis, on the other hand, is more likely to affect the hens. Furthermore, hens' eggs are larger, command the highest prices, and are preferable to pullets' eggs for early hatching.

MANAGEMENT AND FEEDING

The tests to be described involved no difficult procedure, nor any equipment other than that which most poultry keepers already have. The hens used were from various experiments which were discontinued Sept. 3, 1929, when the hens were transferred to another house and carried as one flock. They had previously been confined indoors but, after moving, the birds had access to a fairly

good range. At this time shelled corn was put in mash feeders and kept before the hens at all times, and the mash was restricted to about two-thirds of what would have been consumed had the birds been given free access to it all the time. Oyster shells and chopped alfalfa hay were always available.

TABLE 1.—All-Night Light Versus Morning Light for Winter Egg Production From Hens

Lot number	Per cent egg production			Eggs per bird December 3 to March 1
	December	January	February	
1 All-night light 40 hens	42	55	50	44
2 All-night light 40 hens	48	50	46	42
3 All-night light 60 hens	29	51	57	40
4 Morning light 4:30 a. m. 60 hens	18	46	60	36

The above procedure was continued until December 3, when the best hens were removed for other tests. The remaining inferior hens were divided into four different lots and given all-night or morning light. At this time the shelled corn was discontinued and the all-mash-oats mixture, composed of coarsely ground yellow corn 45, coarsely ground wheat 20, whole oats 15, wheat bran 5, meat scraps medium 10, dried buttermilk 5, poultry bone meal 2, salt 1, cod-liver oil 1, was substituted. No additional grain or moist mash was fed. Results from four groups of hens thus treated are tabulated in Table 1.

DISCUSSION OF RESULTS

These hens might well have had the light, starting November 1, but owing to unavoidable delay they did not receive it until December 3. After this they came into production promptly, especially those given all-night light. For instance, in Lot 1, 40 hens started with three eggs December 3, and six days later laid 23. Lot 2 did practically the same. In Lot 3, of 60 hens, but one laid before December 11; at that date others began, and eight days later they laid 28. The groups given all-night light laid a greater number of eggs in December and January, but in February the hens with morning light slightly exceeded the others. The better production in December from Lots 1 and 2 was due to the better grade of hens used. However, the better hens in this case were only

second grade since they were the ones left after the best had been previously selected for other tests. The hens not only laid well during the winter months but also increased their body weight. The average weight of Lot 3, with all-night light beginning December 3, was 3.45, January 1, 3.60, February 1, 3.68, and March 1, 3.73 pounds per bird. At the same time Lot 4, with morning lights, weighed 3.42, 4.14, 4.05, and 3.71 pounds, respectively.

Eggs from Lots 3 and 4 were hatched each week from January 20 to February 10. Those from Lot 3 were 84 per cent fertile, and 82.5 per cent of them hatched. The eggs from Lot 4 were 88.5 per cent fertile, and 80.2 per cent of them hatched.

METHODS OF PROCEDURE

Each poultry keeper usually accomplishes a given object by a different or modified procedure, because each must be governed by a variable combination of circumstances and conditions. Individuality also plays an important part so that no two individuals accomplish the same object in the same way. This principle applies to poultry keeping in general and to getting winter eggs in particular. Hence no attempt will be made to suggest a definite procedure that will apply to all alike for getting winter eggs from hens. One way by which this object was accomplished by the Station has been described somewhat in detail; it may offer some general suggestions. Further adaptations of the procedure and other suggestions follow:

Molt and recondition the hens in August or September by moving them to different quarters, and, if possible, by giving them a good outdoor range of blue grass, clover, or alfalfa. At the same time give the hens free access to shelled corn in suitable feeders at all times. To insure a more liberal consumption of shelled corn the mash should be limited to about one-half or two-thirds the amount they would eat if given all they cared for. The change to heavy feeding of corn is to discourage egg production, hasten the molt, and fatten the hens so they will be in condition to withstand winter egg production. About two months after the corn-restricted mash, range, and molt treatment, the hens will usually be in condition to be transferred to winter quarters where they are confined and given a suitable winter laying ration and all-night light to insure the heavy feed consumption essential for winter production. The ration should contain, on the basis of total feed consumption, not less than 10 per cent meat scraps or its equivalent, 5 per cent dried buttermilk or skimmilk, 5 to 10 per cent highest quality alfalfa

meal, and 1 per cent of a potent cod-liver oil or its equivalent, in addition to the corn, wheat, oats, bran middlings, etc., which serve to make up the greater proportion of the feed. The ration may be fed as one feed mixture or grain and mash may be fed separately if so desired. If both grain and mash mixtures are employed the grain should be fed in mash feeders, on top of the mash, but never in the floor litter which is always more or less unsanitary. The open box type of mash feeder 8 inches wide and 4 inches deep inside—as described and illustrated in Circular 14—which will provide 30 feet of feeding space, counting both sides of feeder, for leghorns, and 40 feet for heavier breeds, is a necessity if the desired winter egg production is to be secured. Such feeders with ample feeding space provide the best means for feeding grain (if it is to be fed separately), moist mash, condensed buttermilk, or germinated oats—simply put such materials in the mash feeders on top of the dry feed. Moist mash may, or may not, be fed, as may be preferred—it is not essential. But it is essential to have warm water available both night and day. This is easily accomplished by use of a simple, inexpensive, electrical water heating device, Figure 1.

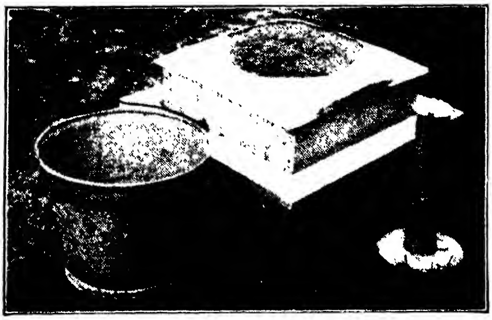


Fig. 1.—Warm water device

KINDS OF HENS TO USE

The hens to be selected for winter eggs should be in good condition, vigorous, and up to size; that is, they should show no indications of being afflicted with disease or intestinal parasites. Yearlings are much to be preferred, altho two-year-olds may sometimes be used to advantage; older hens would seldom, if ever, prove suitable.

The pullets which laid well during the previous winter and continued in heavy production the following spring and summer afford an important source of yearling hens. Such hens generally fall off in production after July and become available in August or September. After being reconditioned by the fall molt and rest period, they are particularly well adapted, not only for winter egg production, but for high quality, early hatching eggs.

The largest source of hens is those displaced by the pullets in August and September. On this account thousands of valuable yearling hens go to market each year, which, if properly prepared for winter production, could in many instances be made more profitable than the pullets that displaced them.

There are also the hens which for one reason or another molt early. The practice has been to market these birds in July, August, and September. However, such hens, if in good condition, may well be separated from the late molters and prepared for winter production. Where a special breeding flock is maintained the early molters can be selected and prepared for winter production while the late molters can be continued in production so as to qualify finally for the breeding flock.

Getting winter eggs from hens offers an opportunity for some who do not have the room or facilities to raise first class pullets, or those who fail with pullets, to succeed without having to raise pullets or depend on them for winter eggs. In every community there is a splendid opportunity for a few such enterprises which should prove very profitable for one who knows a good hen when he sees it; he can go out and purchase suitable hens which are plentiful in August. The select hens could be kept for winter egg production, and the others not qualifying for this purpose could be marketed. The hens kept for winter egg production might in many cases be sold in the spring when eggs become cheap, or after they are no longer desired to produce hatching eggs. At this time market poultry usually commands a better price and the hens would often sell for more, after laying 3 to 4 dozen high-priced, winter eggs, than they cost before; whereas the pullets, which usually lay about the same number of smaller eggs, would suffer a depreciation of about 75 cents each when they became hens in the spring.

For example, Charles Tessmer, Hartman, Ohio, who is making it a practice to keep only hens for winter eggs, secured 500 hens for 49 to 79 cents a head in the fall of 1929, and after securing an average of approximately 50 per cent egg production during the winter months, sold them on the market in April for $1.10. In this case the increased value of the hens from fall to spring more than paid for their feed during the fall molt and reconditioning period.

Other poultrymen, particularly those in southeastern Ohio who were the first to employ all-night light for hens, have been succeeding in getting profitable winter egg production. It seems that J. E. Morris was the first to start this practice in 1925, and during the past five years others in that section have likewise succeeded.

In general their practice has been to molt and recondition the hens in September and October and start the all-night light around November 1, when the hens promptly come into 40 to 50 per cent production, which they maintain thruout the winter months.

WARM WATER FOR WINTER LAYERS

Warm water is one of the essentials for best winter egg production. Hens drink sparingly of cold water, but relish warm water. A liberal intake of water increases egg production by stimulating feed consumption and supplying the large amount of water required for egg formation.

The insulated water pail and electric heater illustrated in Figure 2 is a simple, effective, and inexpensive device for its purpose. This outfit with a 16-quart pail amply serves 100 layers.

Insulation of water pail.—The construction of a box container is self-explanatory from the photograph, Figure 1, and the sketch, Figure 2. The galvanized iron cover is cut to fit snugly under the rim of the pail, and sloped so as to carry off drip water to keep the inside packing dry. The bottom of the box is removable so as to

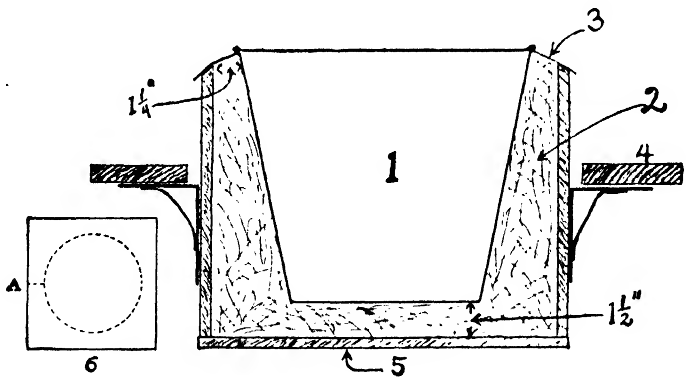


Fig. 2.—Insulated water pail and container

1. 12, 14, or 16 quart galvanized water pail.
2. Straw or excelsior for insulation.
3. Galvanized sheet iron top to keep insulation dry.
4. 1- by 3-inch running board.
5. Removable bottom.
6. Sheet iron top marked for cutting.

pack easily or renew insulation around the pail. When the box with iron cover is completed the pail is put into place and the box turned upside down so as to pack straw, excelsior, or newspapers firmly around the pail. The bottom is then fastened in place. The pail can then be removed when desired and the packing will stay in

place. One packing will usually last thru the winter season. The 1- by 3-inch boards for hens to stand on are placed 4 inches below the top of the pail and one inch from the box. The size of box provides $1\frac{1}{2}$ inches of space for packing between the top edge of the box and the pail.

A simple inexpensive electric heater.—Figure 1 shows a simple electric heater which has been used at the Ohio Experiment Station during the past three winters and has proven highly satisfactory. It consists of a piece of galvanized iron conductor pipe 12 inches long and $2\frac{1}{2}$ inches in diameter, water tight at one end. To this bottom end a six-inch disc of galvanized iron is attached so as to keep the heater upright. Then one inch of sand is put in the bottom and an extension cord inserted in such a way that the bulb rests on the sand. More sand is then added to fill around bulb and to a point three or four inches above so as to hold the heater on the bottom of the pail when it is full of water. A tin cap is put on top of the heater to keep out any water the hens might flip about, as the heater must be kept dry inside to prevent a short circuit. Carbon filament bulbs are best suited for heating as they give off more heat and less light than other types. Bulbs of 16 to 50 candle power may be used depending on requirements. If carbon filament bulbs are not available locally they can be secured from wholesalers of electrical supplies.

ALL-NIGHT LIGHT FOR LAYERS

It seems that all-night light can be used to advantage for securing winter egg production from hens and late hatched or slowly maturing pullets. Only a dim light is required. A 16-watt bulb properly located will serve a pen of 100, and a 25-watt bulb, 200 layers. The use of all-night light is little, if any, more expensive than morning or evening lights, when more intense light is used, and requires less expensive equipment because of its simplicity.

Obviously all-night light is the best method when gas and lanterns are used as these cannot be turned off and on automatically as can electricity. Success with all-night light is largely determined by having warm water available both day and night, suitable feeders providing ample feeding space, and a light located over the feeding and drinking equipment so the birds can easily see to eat and drink. The light may or may not be shaded. If shaded

produced eggs which hatched somewhat better than the others. Whether this means that germinated oats can be depended upon to improve hatchability or not will need to be determined more definitely by further tests. The rations with or without oats did not appear to affect the mortality of the birds.

The tests did not prove definitely the best way of feeding oats. On the contrary, they seem to indicate that the method of feeding is best determined by personal preference and convenience. Furthermore, there appeared to be no advantage in hulled oats over whole or ground oats.

While the tests in question were consistently in favor of oats where used to replace 20 per cent of the yellow corn in all-mash rations containing 70 per cent corn, it should be emphasized that even the oats rations carried 50 per cent corn. The effect of a further replacement of the corn by oats, other grains, or their by-products, and the optimum amount of corn for layers are questions not covered by the tests. Furthermore, a good quality of heavy oats, about 35 pounds per bushel, was used. How the results might have been affected had a poor quality or light oats been used is still another question not answered.

THE PROGRESS OF HESSIAN FLY IN OHIO

T. H. PARKS, Extension Entomologist

The annual wheat insect survey, conducted by the entomologists just previous to wheat harvest, gives us some idea of what to expect from the Hessian fly during the next year. Twenty counties were visited in the main wheat-producing sections and a census of this insect was taken. The percentage of stalk infestation was determined in each field visited and the average infestation for all of the fields visited constituted the percentage of infestation found in that county.

The records taken in these twenty counties, when compared with those taken in the same counties one year ago, show that the Hessian fly has increased in Ohio from 4.6% of the straws infested in 1929 to 6.8% in 1930. It increased slightly in all but three counties. The heaviest infestation was again found to be in Butler County where 34 per cent of the straws were found to be infested with Hessian fly. A group of counties in southwestern Ohio now

have over ten per cent of the straws infested which is looked upon by the entomologists as the point beyond which danger lies. This is especially true if the insect has made a rapid increase over last year. The remainder of the State has no very great amount of Hessian fly present. The situation is, excepting last year, the best since these surveys were commenced in 1918.

Chart 1.—Figures in counties denote per cent of straws infested

During the survey the entomologists again had their attention called to reasons for high infestation as found in some fields. In Butler County a field of barley sowed early in the fall of 1929 was observed in November to be destroyed by the fly. It was not plowed under and an adjoining field of wheat, sowed after the safe seeding date, became badly infested by the spring brood of the insect, having 84 per cent of all straws infested at harvest time.

Many of these were lodged. In Erie County, where the fly was not much of a pest this year, a field of wheat sowed two weeks before the proper date developed an infestation of 56 per cent.

The situation for the next year is not alarming and serious Hessian fly damage is not expected over most of the State. Butler County, with almost three times as many of the insects as surrounding counties, apparently has maintained its infestation through the habit of seeding wheat early in standing corn stalks. Where the fly is known to be present in numbers that constitute a menace, wheat should not be above ground before egg laying ceases. The safe seeding date in northern Ohio is September 22 for Williams, Fulton, and Lucas Counties and progressively later as we go southward. In Clermont and Highland Counties, the date is October 3. These dates remain permanent and are not subject to change by observations made this year. At the Wooster Station and the county experiment farms wheat sowed on a fertile and well prepared seed-bed yields highest when seeded on or near the safe seeding date to avoid Hessian fly damage.

The entomologists found other wheat insects and wheat diseases to be of little consequence this year.

PRUNING STUDIES WITH THE CUMBERLAND BLACK RASPBERRY

J. S. SHOEMAKER

Previous experiments with the Cumberland black raspberry have indicated that, within reasonable limits, (1) the lighter the pruning (heading back of laterals or branches) the more the berries produced, (2) the heavier the pruning the larger the size of the berries, and (3) the degree of pruning required for best correlation between size of berries and total production of berries is influenced by the vigor of the plants.

The experiment reported here was conducted in the Cumberland plantation at the Ohio Experiment Station, Figure 1. The planting distances in this plantation are 3 x 9 feet. There are 10 rows in the plantation, each row containing about 85 plants. The plantation was set in the spring of 1928. The pruning treatment and yield are for 1930, when the plantation bore its second crop.

The plantation (slightly more than one-half acre) received about 125 pounds of sulfate of ammonia in 1928 and 1929, and about 125 pounds of nitrate of soda in 1930.

The laterals of the plants in one half of the plantation were headed back to 8 to 12 inches and in the other half to 6 to 8 inches.

Fig. 1.—Cumberland black raspberry plantation at Ohio Experiment Station during the picking season

The experiment was conducted primarily to determine the effect on yield of the two pruning treatments on plants of good vigor. The plants were vigorous, considering the exceptionally dry growing season of 1930.

The data obtained, Table 1, show that the plants headed back to 8 to 12 inches produced more quarts of berries for the season than those pruned to 6 to 8 inches; in other words, the heavier pruning reduced the total yield. The more heavily pruned plants outyielded the lighter pruned in the last three pickings, but these pickings were comparatively small.[1]

In so far as differences in size of berry occurred, the berries from the plants with the laterals pruned to 6 to 8 inches were slightly larger than those from plants pruned to 8 to 12 inches. During the first few pickings all the berries were of splendid size. Later the size of berries decreased, that from the 8- to 12-inch pruning treatment somewhat more than from the 6- to 8-inch treatment. Only near the end of the picking season was there much fault to be found with the size of berries. At this time the more heavily pruned plants produced the largest berries, but, as previously mentioned, these pickings were comparatively small.

[1]It may be of interest to note that as soon as cherry picking in the Station orchards was completed many robins came to the berry plantation and reduced the crop of berries harvested in the last few pickings. If the robins had not been so destructive an additional picking might have been made.

Altho the experiment furnishes a comparison of the two pruning treatments, it does not definitely indicate the best amount of heading back for all conditions. The summer of 1930 was exceptionally dry, and the results may not be directly applicable to a summer with a more plentiful water supply, or to other conditions. The optimum amount of pruning, in our opinion, is influenced by the vigor of the canes and other conditions.

TABLE 1.—Yield of Berries from Two Pruning Treatments on Cumberland Black Raspberry Plants*

Laterals pruned to	Row	June				July					Total
		23	25	27	30	3	5	7	9	11	
In.		*Qt.*	*Qt.*	*Qt.*	*Qt.*	*Qt.*	*Qt.*	*Qt.*	*Qt.*	*Qt.*	*Qt.*
8 to 12	1	10	16	25.0	25.0	10.5	6.5	2.75	1.00	.75	97.50
	2	10	16	24.5	21.0	10.0	5.5	2.50	1.00	.25	90.75
	3	9	15	25.5	21.0	9.0	5.5	2.00	.50	.25	87.75
	4	12	17	26.5	26.5	8.5	6.5	3.00	1.00	.25	101.25
	5	9	15	22.0	23.5	8.0	5.5	2.75	.75	.25	86.75
Total	......	**50**	**79**	**130.5**	**117.0**	**46.0**	**29.5**	**13.0**	**4.25**	**1.75**	**464.00**
6 to 18	6	7	9.5	16.0	18.0	7.0	6.0	2.25	1.75	1.00	68.50
	7	4	10.5	17.0	14.5	6.0	4.25	3.50	1.75	.75	62.25
	8	6	11.5	17.5	15.5	7.5	5.25	4.00	2.25	.75	70.25
	9	7	14.5	22.0	20.5	6.5	6.00	3.50	1.25	.25	81.50
	10	6	14.0	19.0	17.5	7.0	4.50	2.25	1.00	.50	71.75
Total	......	**30**	**60.0**	**92.5**	**86.0**	**34.0**	**26.0**	**15.5**	**8.00**	**3.25**	**354.25**

*The plants were vigorous considering the dry growing season.

The thought may occur to the reader that it would be advisable to prune more lightly than to 8 to 12 inches of lateral growth. With very vigorous plants this might be advisable but in the average plantation too light pruning may be detrimental, and a number of such instances have been observed this year thruout the State. It is hoped to continue the pruning studies for a report on effects under more favorable growing conditions than occurred in 1930.

KILLING FIELD WEEDS WITH CHLORATES

C. J. WILLARD

SODIUM CHLORATE IS A FIRE HAZARD! READ PAGES 165 TO 167 BEFORE USING !

In the never-ending fight against noxious weeds, our newest allies are the chlorates, especially sodium chlorate. Additional knowledge concerning chlorates is being secured very rapidly, and this article has been prepared to give the most recent available information about them.

In 1929 the Ohio Agricultural Experiment Station sprayed over 400 different plots of field weeds with chlorates, many of them two and three times, and at several different localities in the State. There has now been opportunity to check up on the results of these sprays, as evidenced by the presence or absence of weeds on the plots this spring and summer.

Despite this large number of plots, the many experiences of farmers and county agents in many sections of the State, and the very extensive experiments and experiences in other states, the use of chlorates is still experimental. The results of using them are influenced by so many factors that we cannot predict certainly what the result of any particular application will be. For example, two series of sprays were applied to quack grass just two weeks apart. One pound per square rod in one series gave a better kill than four pounds per square rod in the other. Similar experiences have frequently been reported, and certainly there are factors in the effectiveness of chlorate sprays which are not yet understood.

Nevertheless, the chlorates are so decidedly our most effective chemical weed killers that we have no hesitation in recommending their use in certain situations, if the necessary precautions are followed. The practical recommendations following are necessarily tentative and subject to change as new information is secured.

Where shall we use chlorates?—Chlorates are recommended for **small areas only.** The cost of eradicating noxious hardy perennials like Canada thistles and quack grass with chlorates will usually range from forty to sixty cents a square rod. Obviously not many acres can be treated at this cost. But where a few square rods of weeds threaten an entire farm if they are not eradicated, chlorates, with all their present uncertainties, are perhaps the simplest and most economical method of control available. Chlorates are also valuable in fence rows and rocky areas where cultivation is difficult or impossible. It is not desirable to use chlorates on annual weeds which are readily eradicated by hoeing. They kill crop plants as well as weeds so that in only a few unusual instances can chlorates be used to eradicate weeds in crops, pastures, or lawns without killing all vegetation.

How shall we use sodium chlorate?—Sodium chlorate is usually used as a spray, dissolved in water at the rate of one pound of chlorate to one gallon of water. The material is readily dissolved by placing it in a sack and hanging it at the **top** of the required amount of water. The exact strength of the solution is

not usually important, except as a convenient method of distributing a certain amount of the chemical uniformly, but the pound-to-the-gallon solution has proven very satisfactory for most weeds. The spray may be put on in any convenient way, so long as every part of the plant is well covered with spray. Since more spray is usually applied than is necessary to wet the plants, the fine, misty spray which is so important with other spray materials does not seem to be important for chlorates, and any method which applies the material uniformly may be used. For stronger solutions a fine, misty spray would be necessary to secure uniform distribution. For small areas a sprinkling can may be used, but it is difficult to make a uniform application in this way. The common three gallon compressed air sprayer is more satisfactory. For large areas various types of power spray machinery can be used.

How much sodium chlorate should be applied?—No very definite rules as to the amount to apply can be given. To eradicate most weeds completely at one application requires a very heavy application. If several sprays are applied, applying a second and a third spray as soon as healthy new growth appears after the preceding spray, lighter applications can be used. Only rarely have we succeeded in completely eradicating quack grass or Canada thistle at one application with less than four pounds to the square rod. Even this amount has not killed all the plants under unfavorable conditions. In one or two instances as small an amount as two pounds has killed all the plants at one application. Since, in practice, it is almost impossible to cover a patch sufficiently uniformly to kill every plant at one spraying, the most practical recommendation for small areas seems to be to apply two pounds to the square rod at the first application. If conditions are unusually favorable, this may practically complete the job; usually, however, one, two, or three additional sprayings will be necessary as healthy sprouts appear. These sprayings will not require as much material, probably one pound to the square rod on the average, so that at least four or five pounds of chlorate per square rod will be needed for complete eradication.

It should be noted that unless chemical treatment is one hundred per cent effective, the entire effort is essentially wasted. It is, therefore, better to put on a little more than necessary and have the weeds killed, than to put on a little less than necessary and have, perhaps, no apparent result. The above recommendations contain a considerable "factor of safety" in that under the most

favorable conditions it may be possible to use less material. Even the above amounts, however, will not be effective under the worst conditions.

Time of year to spray.—The best time of year to spray is not entirely clear. In the 1929 experiments early spring sprays were particularly successful, and so far in 1930 the early May sprays have been more effective than those of later dates, but this is somewhat contrary to the general experience of other investigators. Our experiments agree with those of most other investigators in that chlorate spraying is particularly successful in the early fall months. With reference to the condition of the plant sprayed, most perennial weeds are weakest as they come into bloom and seem especially susceptible to spraying at this time. Taking these facts into account, and also considering the usual distribution of farm work, it seems likely that summer and fall are the most practical times for spraying. However, it seems fairly clear that any sprouts which appear on areas sprayed the preceding year should be resprayed at least as early as May.

Other conditions affecting spraying.—Soil conditions are particularly important in using chlorates. Contrary to what might be expected, damp weather and moist soil are particularly favorable for satisfactory results in chlorate spraying.

Rain has little effect on chlorate spraying unless a heavy rain comes immediately after the spray is applied. This may wash the chlorate off the plants and into the drainage ditches so that it has little effect.

In practical weed eradication, the most serious problem is to find all the plants in the patch at the first spraying. It is worth while to go back a few days later and spray plants missed the first time.

It is very clear that the amount of reserve materials in the roots has an important bearing on the effectiveness of chlorate sprays. Any treatment which has reduced the amount of stored materials in the roots has increased the effectiveness of the spray.

Cost of sodium chlorate.—Like all commercial products, the price of sodium chlorate varies sharply with market conditions. Ordinarily it should cost ten to twelve cents a pound delivered in Ohio in the original 112- or 224-pound drums. At retail it would cost more, but in the writer's opinion sodium chlorate should not be handled in small retail lots because of the fire hazard both to the dealer and the purchaser. Certainly a dealer cannot afford to take the risk involved in storing this material and selling it in small lots

for any reasonable profit in selling it. A 112-pound drum of sodium chlorate does not represent a large investment, and if purchased in this way and stored carefully there is no necessary reason for trouble from its use.

SPECIAL DIRECTIONS FOR CERTAIN WEEDS

Canada thistle[1].—One of the most effective methods of attacking Canada thistle has been to spray once as it came into bloom in June or early July, and once or twice more in the fall as healthy sprouts appeared. In several instances two or three sprays in this way have completely eradicated thistles. The patch should be watched the next year, however, as occasional sprouts may need respraying then.

Another very effective combination on Canada thistle has been to mow the patch as it came well into bloom and then spray heavily after growth has started in the early fall. In 1929 this combination was more consistently successful than any other method of making a single application of chlorate. This suggests that a desirable time in the rotation to start work on Canada thistle is in small grain stubble, just after the grain is out of the field. The binder should be set as low as possible in harvesting, and the areas sprayed after some recovery has been made. Use the full amount of chlorate, even though the growth is reduced. The sprayed spots will be visible in the clover or grass the next year, and spraying of areas not killed the year before is simplified.

It has been rather noticeable in thistle spraying that the dense, center parts of the thistle patches are more readily killed than the plants at the edge. In spraying Canada thistles special attention should be given to the outlying plants, giving them a heavy application. It is probable that spraying the ground or vegetation around the outlying plants for a distance of at least 18 inches is desirable.

Quack grass[2].—Here again two or three sprays, one in June or early July, and the others in the late summer or early fall after re-growth has occurred, have been very effective. The most effective treatment in the 1929 experiments was to plow the area containing quack early in July and then spray one or two months later after growth was well started. Plots treated in this way consistently required less chlorate for a complete kill than did plots which were simply mowed to prevent the quack grass going to seed. In areas in which there are spots of quack here and there, plowing

[1]*Cirsium arvense*. [2]*Agropyron repens*.

has the very great additional advantage of making the quack grass spots readily visible. In practical eradication operations the most serious difficulty is that the operator does not find all the plants the first time over the area.

Poison ivy[3].—This universally distributed pest of roadsides and fence rows has been very easily killed by applications of two to three pounds to the square rod of sodium chlorate at almost any time of year. Occasional plants will need re-spraying, but one application has been quite effective.

Hedge bindweed[4] or "peavine".—This plant is a close relative of the field bindweed[5] or morning glory which has been one of the most important plants sprayed in the western states. Either species can be eradicated in Ohio by the methods outlined for Canada thistle. Where present, however, these plants are so generally distributed and so readily controlled, even though not eradicated, by cultivation, that in this State it is questionable whether or not it is practically desirable to spray them.

Ironweed[6].—This common pest of rich bottom pastures has been over 95% eradicated by a single spray in July when the plants were in bloom. Enough solution (one pound to the gallon) was applied to wet each plant thoroughly. Applied in this way the bluegrass was not killed except in areas six or eight inches across where the plants stood. Whether ironweeds injure a pasture sufficiently for this to be a practical method of eradication is a question.

White snakeroot[7].—This dangerous, poisonous plant which is found in many Ohio pastures has been readily eradicated by the method outlined under ironweeds.

Ox-eye daisy[8].—A solution of eight ounces to the gallon applied at the rate of one gallon to the square rod has completely killed ox-eye daisy, and has not materially injured the bluegrass, in several different experiments in July and later.

Difficult weeds to kill.—In our experiments and those of other investigators, wild onion or wild garlic[9], milkweed[10], and horse nettle[11] have proven especially resistant. We do not at this time recommend chlorates on these weeds.

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[3]*Rhus toxicodendron.* [4]*Convolvulus sepium.* [5]*Convolvulus arvensis.*
[6]*Vernonia altissima.* [7]*Eupatorium urticaefolium.* [8]*Chrysanthemum leucanthemum.*
[9]*Allium vineale.* [10]*Asclepias syriaca.* [11]*Solanum carolinense.*

OTHER EFFECTS OF CHLORATES

What is the effect of sodium chlorate on the soil?—Sodium chlorate does not permanently sterilize the soil. Immediately after spraying, seedlings will not grow. The length of time that chlorate will stay in the soil and affect crop plants depends upon soil and climatic conditions which we do not now understand, and upon the resistance of the crop sown. Wheat will usually be killed if sown in the fall following summer sprayings. Clover the following spring has not usually been affected. Oats have shown some yellowing when sown on land that had been heavily sprayed the preceding year, but have recovered without much apparent injury. In one instance, at least, corn was considerably injured the year following an application of chlorate spray. It would seem safest to count on more or less injury to the crop immediately following chlorate spraying. There seems to be no injury whatever after one year. This temporary sterilization of the soil is valuable in making the sprayed area easily located, and weed sprouts, if any, easy to see.

Is sodium chlorate poisonous to stock?—The Minnesota Experiment Station has published an account of administering sodium chlorate to two cows in capsules and causing pathological symptoms. Dr. Robert Graham, of the University of Illinois, has kindly given the writer unpublished data on administering up to nearly one-half pound of sodium chlorate at one time as a drench, both to horses and to cattle. In these experiments the chlorate in that amount produced no injury. A significant practical fact is that no case of poisoning from chlorates sprayed on vegetation has ever been reported, despite the thousands of tons of these materials which have been used for weed killing in the past five years. Observations of well-salted cattle show that they pay no particular attention to sprayed vegetation when turned into a pasture containing it. It is certainly a desirable precaution to see that stock have been well salted before turning them into a pasture containing freshly sprayed weeds. With this precaution, the danger from poisoning of stock is remote.

Effect of chlorate on orchard trees.—One of the most important possible advantages of sodium chlorate would be the eradication of weeds in orchards, if this could be done without injuring the trees. A considerable number of applications to weeds under orchard trees has been made to test out this question, but our data are still too limited for any positive conclusions. Weeds have been

sprayed under apple, pear, cherry, and peach trees. Of the four, the peach seemed to be the most susceptible. Two peach trees about 12 feet high and 12 feet in spread were apparently killed by an application of eight pounds to the square rod, and similar trees were apparently severely injured by four pounds to the square rod. Some of the pear trees receiving four and eight pounds to the square rod were somewhat yellowed. No injury has yet appeared on cherries which received eight pounds to the square rod in two applications, nor on apple trees from the same amount. Twelve pounds to the square rod have apparently injured one apple tree severely. These rates are all much heavier than are required to kill herbaceous weeds, so that it would seem that it may be possible to kill weeds in orchards without killing the trees.

Despite these favorable results, we would advise orchardists if they wish to experiment with chlorates to use comparatively light applications, to be particularly careful to keep the spray off the trees, especially the leaves, and to use the material under a few trees before risking an application on an entire orchard. It is readily possible that the trees will be more seriously injured on some soil types than on the ones on which we worked, or that different varieties of the same fruit may differ in susceptibility. It would be wise to wait at least a year before deciding that the trees had not been injured.

CAUTION ! ! !

Sodium chlorate must be handled carefully.—It is a serious fire hazard. The material itself cannot be burned or exploded, but when it is mixed with, or in contact with, combustible material, such as sulphur, starch, wood, straw, cotton, or any other plant product, it causes an explosion if struck, or burns very rapidly if ignited.

Potassium chlorate is an important ingredient of match heads, and sodium chlorate can be used in the same way. Clothing, sacks, straw, barrels, or other materials which have been wet with sodium chlorate solution and then dried may take fire from simple friction, like a match, as well as from a heavy blow. For example, a Franklin County farmer threw some planks on a stoneboat on which he had hauled sodium chlorate spray a week or two before. It burst into flame, and set fire to a straw stack beside which he was working. Fortunately, no buildings were near by, but they might have been. Sodium chlorate spilled and ground into the floor of a barn or machine shed may set the building on fire months later when an iron wheel runs over the floor, or some other source of a

spark ignites it. An Ohio boy living near Plain City had had his shoes soaked with chlorate spray, and some days later touched his foot against the hot exhaust pipe of his tractor. The shoe burst into flame, causing burns from which he was still limping six months later. Scratching a match on a pair of dry unwashed spraying overalls has also been responsible for serious burns. A Champaign County man spent ten months in the hospital last year from such an accident. Don't take chances with sodium chlorate: you may furnish the next accident if you do.

We can deal with sodium chlorate better if we understand exactly what it does. Most of us have watched a garage man burn the carbon out of automobile cylinders, feeding oxygen from a tank into the cylinders to make the carbon burn as it would not in the dilute oxygen furnished by the air. Chemically, sodium chlorate is practically a tank of oxygen in solid form. It furnishes oxygen to any burnable material just as quickly as the tank does. Throw a pinch of sodium chlorate on a fire and at once you get the same flashing, sparkling, extremely rapid burning that we see in the auto cylinder. On the other hand, if you hold a lump of sodium chlorate above a blue gas flame, there is no unburned fuel for it to combine with, and it will simply melt. Again, this is like the auto cylinder into which oxygen could be fed indefinitely after the carbon is burned out without getting any fire.

Some concern has been caused among users of sodium chlorate by the sticker, "Do not drop", frequently found on drums of the material. In the freight tariffs sodium chlorate is classified as an explosive and this "yellow label" sticker, saying "Do not drop", is put on all such shipments, just as "Glass" is put on many shipments which are classed as fragile, though there may not be a particle of glass in them. A drum of sodium chlorate as received can be handled with impunity, but if a little sulphur, sugar, starch, or any other finely divided burnable substance is mixed with it, and the mixture struck, it will cause a dangerous explosion. In farm use, sodium chlorate is more dangerous as a fire hazard than as an explosive. The following precautions will help to insure safety in handling the material:—

FOLLOW THESE PRECAUTIONS !

1. Use metal containers for sodium chlorate solution if possible. If necessary to use wooden containers or spray tanks wash them out thoroughly after using and then let them stand full of pure water for several days or weeks before emptying. As far as possible, keep them moist thereafter.

2. Wear rubber boots when spraying. Shoes once soaked with the solution are difficult, almost impossible, to free from it.

3. Do not use matches around spray clothing that has dried out. To do this is rather less safe than striking a match to see how much gasoline is in the tank.

4. Wash thoroughly or destroy all clothing, sacks, or other cloths which have become soaked with the solution. Usually it is possible to conduct the spraying in such a way as to keep the solution off one's clothes, but it should never be allowed to dry on them.

5. Avoid spilling the dry salt or the solution on floors, walls, wagon beds, etc. Sweep up or wash off any that is spilled as soon as possible. Keeping equipment well painted reduces the danger from absorbing the solution.

6. Always store or carry sodium chlorate in tight metal or glass containers, not in cloth or paper sacks. Sodium chlorate takes up water in damp weather, so much that it may dissolve. Sacks, and floors under them rapidly become dangerous fire hazards from absorbing the dissolved chlorate and then drying again. Several automobile fires have resulted from sodium chlorate which had sifted out of cloth sacks.

7. Keep sodium chlorate tightly covered to keep out all foreign material which might make an explosive mixture. Sulphur in any form is especially dangerous and should not be stored in the same room with sodium chlorate.

8. Keep sodium chlorate away from children as you would any other dangerous material.

9. Store sodium chlorate in a detached out-building, and make up solutions outdoors.

Calcium chlorate.—The serious fire hazard of sodium chlorate has led to a search for materials which would be equally effective as weed killers and less dangerous. Calcium chlorate and magnesium chlorate attract water so strongly that with ordinary humidities they dissolve in water taken from the atmosphere. They can be dried out only in very dry air. Because of this property of attracting water, in a climate as humid as Ohio material sprayed with them does not often become dry enough to burn. In dry climates or on the driest days here there is a certain fire hazard even with these materials, but it is very much less than with the sodium chlorate.

Calcium chlorate is now commercially obtainable in a patented preparation. This material, however, is not pure calcium chlorate, but is equivalent to about 60% calcium chlorate. Pure calcium

chlorate is not commercially obtainable at the present time. Probably because of this dilution with less effective materials, this preparation has not been equal to sodium chlorate pound for pound under Ohio conditions. This statement is based on 80 different comparisons in 1929 of the two materials used on both Canada thistles and quack grass on many different dates and under a variety of treatments. However, this material is at least as effective as sodium chlorate in proportion to its chlorate content, and is almost certainly more effective than this. Our experiments do not justify a more definite statement.

From the nature of the product one would expect calcium chlorate to be particularly effective in comparison with sodium chlorate when used during dry weather. Experiments in the western states seem to indicate that this is true, and preliminary observations here during the present dry season suggest the same thing. This material can be rather readily applied as a dust; if efficient machinery can be devised for applying it in this form, it will be an important advantage for this product. Its very much greater fire safety is a tremendous point in its favor. As a product for dealers to handle and sell in retail lots, it is far preferable to sodium chlorate. Sodium chlorate is as yet the more economical weed killer for the man who will buy in the original package and will take due precautions.

THE MECHANICAL CORN PICKER IN OHIO

J. H. SITTERLEY

In order to determine the place of the mechanical corn picker on Ohio farms 65 farmers owning and operating corn pickers were interviewed in the fall of 1929. The mechanical corn picker is not a new machine. Over 75 years ago inventors were busy trying to perfect a machine to pick corn from the standing stalk. About 1902 the first practical pickers were developed. Altho available for the past 25 or 30 years the noticeable increase in number of pickers has taken place in the last four or five years. Both one and two row pickers are on the market at the present time. The one-row pickers are the more common as they have been on the market longer than the two-row machines.

The 51 farms on which the one-row pickers were operated averaged 369 acres in 1929 and those on which the two-row pickers were operated averaged 507 acres per farm. Approximately one third of the land in these farms was devoted to corn production. The one-row pickers harvested 86.5 acres and the two-row pickers 300 acres per machine in 1928. For the one-row operators the amount harvested per year ranged from 22 to over 200 acres per year per machine, and for the two-row operators the amount harvested ranged from 110 to 800 acres.

Approximately 3.7 man hours were required to harvest and crib one acre of corn with a one-row picker in 1928 and 2.5 man hours per acre with a two-row picker. Three men, two teams, and a tractor were used to operate the one-row machines; while four men, three teams, and a tractor were ordinarily used to operate the two-row pickers. Hand husking and cribbing from the standing stalk required approximately ten man hours per acre. In the same length of time required by three hand huskers and three teams to husk and crib one acre of standing corn, three men with a one-row picker, a tractor, and two teams husked and cribbed 2.6 acres. The two-row pickers included in the study required approximately one fourth as much man labor per acre in 1928 as the hand method.

The average total cost with the one-row picker was $3.85 per acre or $.07 per bushel compared with $6.47 per acre or $.12 per bushel for the hand method.

The corn picker owners interviewed were asked as to the advantages and disadvantages of the mechanical picker. The following are some of the statements given:

Advantages.—(1) Reduces harvest labor problems; (2) affords faster methods of harvesting corn; (3) makes work easier; (4) lowers harvesting costs; (5) gets corn in crib earlier; (6) can handle more acres of corn.

Disadvantages.—(1) Causes more waste of ears and shelled corn; (2) proves impracticable in wet weather; (3) affords little or no fodder for food; (4) packs the ground; (5) often does not remove all of the husks; (6) requires large investment; (7) proves not very satisfactory when ground and stalks are frozen.

INCOME AND EXPENSES OF THE OHIO AGRICULTURAL INDUSTRY IN 1929

V. R. WERTZ

The estimated gross cash income from Ohio's Agricultural industry was 20 million dollars greater for the calendar year of 1929 than for 1928, but 4½ millions below its average for the five preceding years, 1924-1928.

The increase of 20 millions in 1929 over 1928 was mainly in the income from grain, poultry and eggs, tobacco, and vegetables. These four groups of farm products accounted for an increase of 23 million dollars in 1929 over 1928. The income from livestock and dairy products was only slightly higher in 1929 than in 1928; while that from wool, fruits, and miscellaneous products was considerably lower in 1929 than in 1928.

The two main crops responsible for the increased income in 1929 over 1928 were wheat and tobacco. Ohio harvested 33,770,000 bushels of wheat in 1929 as compared with 9,475,000 the year before. The increased income from tobacco in 1929 was, also, due to a larger volume of sales; tobacco sales amounted to 32,198,000 pounds in 1929 as compared with 24,916,000 the year before.

The farm products chiefly responsible for holding the 1929 gross cash income four and one-half million dollars under its average for the preceding 5-year period were grains, livestock, and wool. The 1929 gross cash income from grains was 12 millions below its previous 5-year average; the livestock income was 3½ millions, and wool 1½ millions under this 5-year average. The slump in the 1929 Ohio grain income from its previous 5-year average was due to a poor wheat crop in 1928 which reduced the quantity for sale in the early months of 1929 and, likewise, to the fact that wheat prices were below average in 1929. A slight decline in the number and price of hogs sold in 1929 reduced the estimated income from livestock below its 5-year average. A decline in the price of wool which was sold in 1929 was responsible for lowering the income from wool in 1929 below its 5-year average.

While grains, livestock, and wool were below their average in incomes in 1929, the income from dairy products, poultry and eggs, tobacco, and vegetables was above its level for the 5-year period, 1924 to 1928.

The estimated cash outgo of the Ohio agricultural industry for business purposes stood at $208,392,000 in 1929 as compared with $196,901,000 in 1928, and an average of $180,214,000 from 1924 to 1928.

The increase of 11 million dollars in expenses from 1928 to 1929 was mainly in expenditure for farm implements and machinery, commercial feeds, and fertilizer and liming materials; these three expenditures accounted for 9 of the 11 million dollar increase in farm expenses.

TABLE 1.—Estimated Cash Income and Outgo of the Ohio Agricultural Industry 1924-1929

	Gross cash income* (Thousand Dollars)	Cash expenses† (Thousand Dollars)	Net cash income‡ (Thousand Dollars)
1924	327,352	155,914	171,438
1925	351,643	174,930	176,713
1926	373,883	180,600	193,283
1927	350,595	192,728	157,867
1928	319,692	196,901	122,791
Average 1924-28	344,633	180,214	164,419
1929	340,236	208,392	131,844

*From the sale of agricultural products.
†Exclusive of interest on capital and wages of management.
‡Gross cash income minus cash business expenses.

Of the 28 million dollar increase in cash outlay of the agricultural industry of Ohio in 1929 over its 5-year average from 1924 to 1928, 10 millions were in farm implements and machinery, 8 millions in commercial feeds, 5 millions in taxes, and 1½ millions in commercial fertilizer and liming materials.

The amount of cash left to the Ohio agricultural industry after deducting the expenses shown in the accompanying table was $131,844,000 in 1929 as compared with $122,791,000 in 1928, and an average of $164,419,000 from 1924 to 1928. This amounted to a net cash income to the capital and management engaged in the Ohio agricultural industry in 1929 7 per cent above that in 1928, but 19½ per cent under the average return during the five years, 1924 to 1928.

OHIO FARMS OWNED BY LIFE INSURANCE COMPANIES

F. L. MORISON

The number of farm mortgage foreclosures in western Ohio in recent years is of concern to farmers, prospective farm owners, real estate men, and officials of financial institutions making farm loans. A study recently completed by the Rural Economics Department deals with the number of Ohio farms acquired by life insurance companies thru foreclosure.[1]

It was found that, of approximately 140 life insurance companies authorized to transact business in Ohio, there were 27 companies owning mortgages on Ohio farm real estate, January 1, 1930. Not all companies reported the number of mortgages, but 23 companies reporting had a total of 10,300 farm mortgages. The average amount still to be paid was $5,485 per mortgage. Individual mortgages ran from 5 to 29 years; more were for 5 years than any other term. Rates of interest on individual loans varied from 5 to 7 per cent.

On January 1, 1930, sixteen of these companies owned a total of 418 farms in Ohio, comprising nearly 65,000 acres. Most of this land is in western Ohio, with the heaviest concentration in Defiance, Paulding, Union, Hardin, and Logan counties. No records were available as to the number of loans made in different sections of the State. There is evidence that most of the companies have selected the northwestern quarter or western half of the State for their Ohio loan territory.

These 16 life insurance companies foreclosed on a total of 179 Ohio farms in 1929, as compared to 164 in 1928, and 58 in 1927. But it is encouraging to note that the number of farms in process of foreclosure on January 1, 1930, was 93 as compared to a total 113 on January 1, 1929.

Sales of these foreclosed farms have not been taking place very rapidly, and hence the insurance companies are making improvements and continuing the operation of their increasing acreages. Most of the farms are being operated by supervised tenants under a crop-share system of renting, combined with a cash charge for pasture. One company however owning a large number of farms, operates its holdings by hired labor.

[1] Rural Economics Mimeograph Bulletin No. 26.

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

The outstanding trend from January to May was a decline in prices. During that period wholesale prices in the United States declined 5 per cent, United States farm product prices 7 per cent, and Ohio farm product prices 8 per cent. Prices paid by farmers for commodities bought, however, remained nearly the same. It is apparent that the decline in wholesale prices has not as yet been reflected in retail prices.

During the first six months of 1930 the cash income from the sales of farm products for the State was seven and one-half per cent below that of the corresponding period of 1929.

Trend of Prices and Wages, 1910-1914=100

	Wholesale prices all commodities U. S.	Weekly earnings N. Y. state factory workers	Prices paid by farmers for commodities bought U. S.	Farm product prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm product prices	Ohio cash income from sales
1913........	102	....	100	100	104	100	105	100
1914........	100	100	101	102	102	102	105	107
1915........	103	101	106	100	103	107	106	110
1916........	130	114	123	117	113	113	121	120
1917........	181	129	150	176	140	119	182	197
1918........	198	160	178	200	175	131	203	243
1919........	210	185	205	209	204	135	218	265
1920........	230	222	206	205	236	149	212	242
1921........	150	203	156	116	164	134	132	136
1922........	152	197	152	125	145	124	127	135
1923........	156	214	153	135	166	122	134	148
1924........	152	218	154	134	165	118	133	150
1025........	161	223	159	146	165	110	159	164
1926........	154	229	156	136	170	105	155	176
1927........	149	231	154	131	173	99	147	163
1928........	153	232	156	139	169	96	154	147
1929........	151	236	155	138	169	94	151	154
1929								
January...	152	234	156	133	166	....	144	145
February..	151	236	156	136	....	....	149	137
March	153	239	156	140	....	94	155	143
April......	152	237	155	138	163	....	150	148
May.......	150	236	155	136	....	....	152	149
June.......	151	236	155	135	....	....	153	155
July.......	154	235	154	140	172	....	157	174
August....	153	237	154	143	....	....	159	163
September.	153	240	154	141	....	....	153	160
October....	151	237	154	140	174	....	151	166
November.	148	233	154	136	....	....	149	159
December..	148	234	154	135	....	....	147	146
1930								
January...	146	235	154	134	158	....	141	152
February..	144	231	153	131	....	....	137	134
March	142	235	153	126	....	90	132	131
April......	142	232	153	127	158	....	136	133
May.......	139	229	153	124	....	....	132	128
June......	....	....	....	....	....	....	130	132

NEW MONOGRAPH BULLETINS NOT PREVIOUSLY ANNOUNCED

No. 444, The Strawberry in Ohio, J. S. Shoemaker. This bulletin considers strawberry culture in general. Experimental results on location and site, drainage, planting, varieties, tillage, fertilizers, mulching, renewing of beds, propagation, and harvesting of strawberries are also presented.

No. 445, The Climate of Ohio, William H. Alexander and Charles A. Patton. This bulletin supersedes Bulletin No. 235 and gives in tabular form a summary of data on precipitation, temperature, snowfall, frost, and sunshine for the state of Ohio.

No. 446, The Forty-Eighth Annual Report.

No. 447, Paper Mulch for the Vegetable Garden, Roy Magruder. Experimental data on the effect of paper mulch on the earliness, yield, and quality of 20 common garden crops are presented. The merits of paper mulching under various conditions are also discussed.

No. 448, Water Soluble Arsenic in Spray Material, H. C. Young. What happens when lime-sulfur and acid lead arsenate are mixed together before and after the material is sprayed on the tree, under what conditions arsenic becomes soluble in the mixture, and the effect produced by "correctives" are given. The effects of temperature, length of time of drying, strength of material, sulfur substitutes, and spray injury are also discussed.

No. 449, Carnation Culture, W. W. Wiggin. Methods of propagation, distance of planting, fertilizers, watering, insect and disease control, and varietal data for carnations are presented in this bulletin.

No. 450, Estimated Income from the Ohio Agricultural Industry, V. R. Wertz. In addition to providing an index to the income from agriculture, the estimates of income and expense contained in this bulletin show the relative importance of the various enterprises making up the total cash income and expenses of this industry.

No. 451, Control of Root Knot Nematodes in Greenhouses, A. G. Newhall. The environmental factors affecting the nematode and the control of nematodes in greenhouses are discussed. Methods of soil sterilization are given in detail, together with the physical, biological, and chemical effects of steam sterilization on the soil.

No. 452, Soybeans and Soybean Oilmeal for Pigs, W. L. Robison. This bulletin gives the results of experiments carried on to determine how soybeans might be utilized to advantage as a feed for growing and fattening pigs, a comparison of different varieties of soybeans for the feeding of pigs, the effects of soybeans on the firmness of pork, and a comparison of soybean oilmeal with soybeans and tankage as a supplement to corn.

No. 453, Variations in Crop Production Costs in Medina County, Ohio, F. L. Morison. This bulletin presents an analysis of the crop production costs over a 5-year period of 23 farms located in the east-central part of Medina County, Ohio. This section is somewhat typical of a large area of northeastern Ohio. The crops studied were corn for grain, corn for silage, oats, wheat, mixed clover and timothy hay, and timothy hay.

SPECIAL CIRCULARS RECENTLY RELEASED

No. 27, Field Work of the Ohio Agricultural Experiment Station. Experiments with all the common field crops are explained and illustrated in some fifty tables in the new Field Guide prepared by the Agronomy Department. Tests of various treatments for fertility, of various dates for sowing and planting crops, and of various methods of soil preparation are reported. Of special interest are comparisons of varieties of seeds for the various crops, and of various crops suitable for hay. The work covered experiments with corn, wheat, barley, oats, lawn grass, forage crops, the legume hays, timothy hay, Millet, Sudan grass, soybeans, flax, sorghum, and Canada field peas.

No. 28, Poultry. The circular contains several progress reports of experiments testing new features in poultry housing, feeding, and care. Significant results are given on getting winter eggs from hens, the protein requirements of growing pullets, chicken vices and methods of dealing with them, and the advantages of coarse over fine mash. The uses for woven wire in chicken houses and the principles of sun parlors for chicks are also presented.

No. 29, Dairying at the Ohio Agricultural Experiment Station. This circular is a progress report of the work being done by the Dairy Department on building up a herd, feeding and caring for it, and producing high-quality milk. Some of the specific subjects treated are: improved equipment, cost of keeping a bull, processing feeds, levels of protein feeding, the fat-protein relationship in milk, commercial feeds, minerals, the food value of milk, the vitamin content of milk, iodized milk, and skimmilk powder for calves.

No. 30, Horticulture at the Ohio Agricultural Experiment Station. This circular is a report of the findings of numerous experiments on fertilization, spraying, variety tests, and production of apples, strawberries, black raspberries, and various other fruits. Numerous experiments on variety tests, fertilizing, and pruning of vegetables are reported. The use of paper mulch in the vegetable garden is also discussed. A practical flower section is given dealing with such problems as fertilizers for flowers, propagation of evergreen cuttings, own-root roses compared with budded stock, and rooting cuttings.

The Bimonthly Bulletin

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Ohio Agricultural Experiment Station

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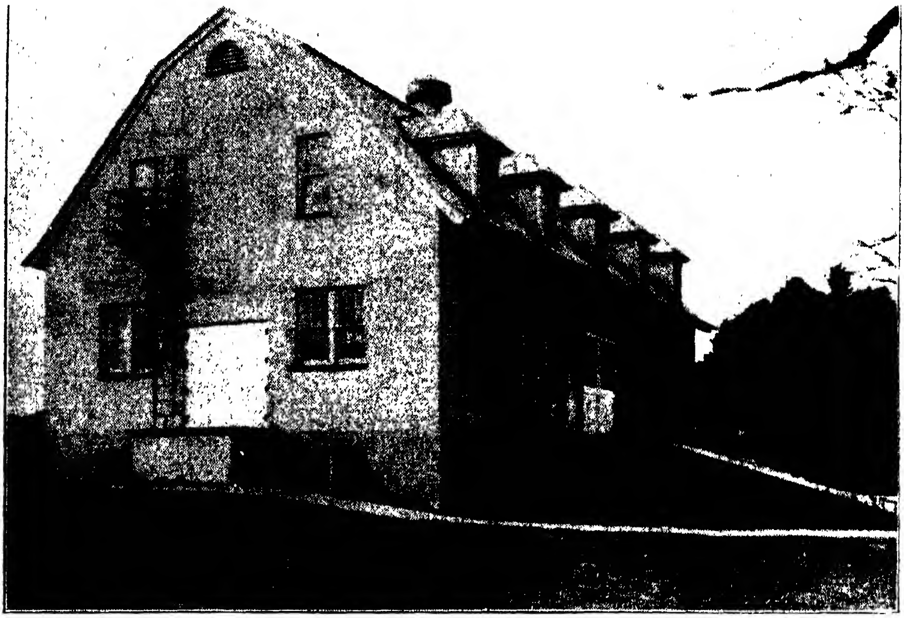
Free Bulletin

C. G. Williams

Director



Crop service building of the agronomy department

THE INFLUENCE OF LAUNDERING AND EXPOSURE TO LIGHT UPON SOME WASHABLE SILKS

MARION GRIFFITH

The practice of weighting silk has been greatly increased in the last few years due to the demand of the consumer for heavier silks. Solutions of tin or iron salts which are used in the process of weighting give the silks a much heavier feel, more body, and an appearance of greater value. The real effect, however, is to decrease the strength of the fabric greatly, due to the "tendering" effect of these metallic salts on the silk fiber. Weighting of silks causes the fabric to split or crack with very little wear. This tendency to split is not found in silks which have not been weighted, that is, pure dye silks.

Studies of weighted silks have been part of the problem of the Textile Section of the American Home Economics Association in attempting to bring about the standardization of fabrics. Margaret Furry, the Textile Section Fellow for 1927-28, analyzed an unweighted silk fabric, a similar weighted silk fabric, and a pongee of wild silk. The silks were analyzed when new and after 25 dry cleanings and 25 launderings. The unweighted silk was scarcely weakened by these treatments while the weighted silk lost about 30 per cent in breaking strength in laundering and about 15 per cent in dry cleaning. The wild silk lost 50 per cent in laundering and 55 per cent in dry cleaning.[1]

The following year, Winifred Forbes, the holder of the same fellowship, in a study of the effect of tin weighting on silk, concluded that weighting by the addition of tin salts causes a partial breakdown of the protein of silks, accompanied by a loss of nitrogen. She further concludes that this is accompanied by a decrease in physical strength as measured by breaking strength, tear resistance, bursting strength, and resistance to abrasion.[2]

Since there is such a large demand at the present time for silks which are washable, it seemed appropriate that a comparison of weighted and pure dye washable silks be made. For this study, which is in progress, washable silks of various types were chosen. A description of the silks is given in Table 1.

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[1]Furry, Margaret with R. Edgar. A Study of Weighted Silk Fabric. J. Home Econ. 20, 901 (1928).

[2]Forbes, W. M. with Pauline B. Mack. The Effect of Tin Weighting on the Nitrogen Content and Physical Properties of Silk. J. Home Econ. 21, 841 (1929).

TABLE 1.—Silks Studied

				Price per yard
				Dol.
A	Mulberry silk	Branded	Pure dye	2 00
B	Mulberry silk	Branded	Pure dye	2.00
C	Mulberry silk	Not branded	Pure dye	3.00
D	Mulberry silk	Branded	Pure dye	2.50
E	Mulberry silk	Branded	Pure dye	2.50
F	Mulberry silk	Branded	Pure dye	2.50
G	Mulberry silk	Branded	Pure dye	3.98
H	Mulberry silk	Branded	Weighted	2.95
I	Mulberry silk	Branded	Weighted	1.98
J	Mulberry silk	Branded	Weighted	1.59
K	Mulberry silk	Branded	Weighted	1.95
L	Mulberry silk	Branded	Weighted	1.69
M	Wild silk	Branded	Pure dye	1.00
N	Wild silk	Not branded	Pure dye	1.00

The practice of branding should be a means of furthering textile standardization if the manufacturer uses this as a guarantee of the quality of his product. A survey of washable silks shows that branding is not always so used. It is possible to obtain both pure dye and weighted silks branded with the name of the same manufacturer. Guaranteed washable silks are often stamped with the words "pure dye" and "washable" on the selvage.

PLAN OF STUDY

For the physical and chemical analyses and endurance tests, white silks are being used. To test the effect of laundering and exposure to light upon color fastness six colors in each brand are being used. The colors are pink, peach, blue, green, yellow, and violet. Each of the silks is being analyzed as to weave, thread count, thickness, yarn count and diameter, fiber diameter, weight per square yard, filaments per yarn, wet and dry bursting and breaking strength, and elasticity. These analyses are being made according to specifications set up in the United States Bureau of Standards Circular No. 345a (1929).

The chemical analyses include determinations of percentages weighting, fibroin, finishing materials, Kjeldahl nitrogen, moisture, water extract, and ether extract.

Shrinkage, thickness, wet and dry bursting and breaking strengths, and elasticity are determined after the silks have been laundered once and 15 times. After the silks have been exposed to the light of the Fade-ometer for periods of 6, 12, 24, and 48 hours they are again analyzed for wet and dry bursting and breaking strength and elasticity. Each hour in the Fade-ometer is considered to be equivalent to 0.17 average days of sunlight during the

months of June, July, and August. The laundering of both the colored and white silks is being done according to the method approved by the American Association of Textile Chemists and Colorists. The amount of fading in the colored silks due to laundering and exposure to light will be determined by the Keuffel and Esser Spectrophotometer.

RESULTS

The fabrics analyzed up to the present time include only pure dye, branded silks. The results show that a very decided fading takes place on exposure to light and during the laundering process. Various colors in the different brands show similar results as to fading. Blue and green show the most fading in both laundering and exposure to light. Violet fades very much with the light but is only slightly affected in laundering. Peach and yellow are only slightly affected by either the laundering or exposure to light.

An analysis of the construction of the silks shows that the higher priced silks are of better construction. This is indicated by the fact that the silks are more evenly balanced as to warp and filling thread count. The size and weight of the warp yarns is very close in value to that of the filling yarns. These factors tend to give a fabric which is as strong in the warp direction as in the filling direction.

The highest breaking and bursting strength is also found in those silks which are of better construction.

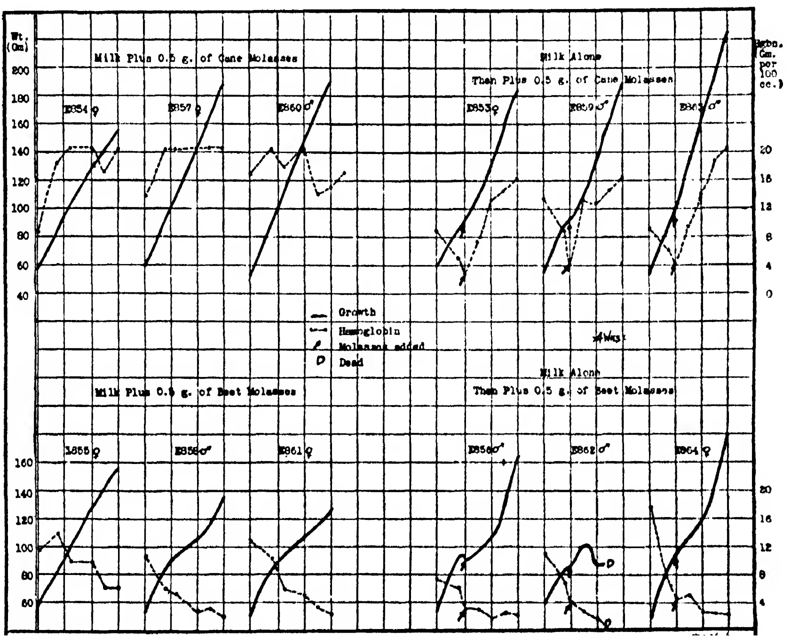
Even all of these pure dye silks show some weighting. The most weighting was found in the lowest priced silk and the least in the highest priced fabric. The highest priced silk contains less than one-third the amount of finishing materials found in the least expensive silk.

Tests of the breaking and bursting strengths and the elasticity of the silks indicate that there is a greater decrease in the strength of the silks due to exposure to light than in the laundering process, and that the decrease in strength after laundering is more nearly uniform for the various silks than the decrease shown after exposure to light. The breaking strength, after 48 hours of exposure to light, ranged from 31 to 69 per cent of that of the new fabrics. The decrease in strength after 15 launderings ranged from 15 to 17 per cent. The silks lost from 25 to 42 per cent in elasticity with 48 hours exposure to light.

THE ANTIANEMIC POTENCY OF CANE AND BEET MOLASSES[1]

W. E. KRAUSS

Young rats fed an exclusive milk diet soon develop nutritional anemia and die. The reason for this has been traced to the fact that milk does not contain a sufficient amount of iron and copper, two substances which have been found necessary for producing hemoglobin (the red coloring matter of the blood). In searching for various foods that would properly supplement milk, cane molasses was tried. The remarkable response obtained by the addition of cane molasses to milk raised the question, "Does beet molasses have the same effect?" To answer this, a sample of beet molasses was fed and compared with cane molasses.



White rats that had just been weaned were allowed access to all the whole milk they would drink. To one group of rats 0.5 of a gram of cane molasses was fed in a separate dish each day, and to a comparable group 0.5 of a gram of beet molasses was fed daily.

[1]The cane molasses used in this trial was taken from the regular supply of molasses fed to cows in the Ohio Experiment Station herd; the beet molasses was furnished by The Purina Mills, St. Louis, Mo.

Another group of rats was fed nothing but milk until anemia developed. Then half of these rats were fed, in addition to milk, 0.5 of a gram of cane molasses daily and the other half 0.5 of a gram of beet molasses daily. Since the presence or absence of anemia can be detected by determining the amount of hemoglobin in the blood such determinations were made on each rat at frequent intervals.

By the above procedure, it was possible to determine the value of cane molasses and beet molasses both as preventives and curatives of nutritional anemia. The results of the study are presented graphically in the chart. The solid lines represent the progress in weight of the rats from week to week; the broken lines represent the hemoglobin content of the blood, determined as a rule every two weeks.

It is very obvious from the curves that the combination of milk and cane molasses allowed excellent growth and maintained the hemoglobin content of the blood at a high level. When cane molasses was added after severe anemia had developed, hemoglobin regeneration was restored and the blood was soon normal. On the other hand, the combination of milk and beet molasses resulted in retarded growth and did not prevent the development of anemia. Also, the addition of beet molasses to the diet of rats suffering from nutritional anemia had no beneficial effect.

To explain these results chemical analyses of the ash or mineral matter in the two kinds of molasses were made. It was found that the cane molasses contained much more iron and copper than did the beet molasses. Since these two elements had previously been shown to be essential for hemoglobin regeneration, it was concluded that the superiority of the cane molasses was due to its higher copper and iron content.

It must be remembered that in livestock feeding the nature of the ration is usually such as to furnish sufficient amounts of iron and copper, and that thus far young pigs are the only farm animals that have been shown to suffer from nutritional anemia. Also, samples of cane and beet molasses obtained from different sources might differ sufficiently in chemical composition from the samples used in this trial to cause different results.

HOW MUCH PROTEIN IN THE GRAIN MIXTURE WILL RETURN THE DAIRYMAN MOST PROFIT?

A. E. PERKINS[1]

It is quite generally accepted that for best results in milk production, the dairy cow should have a somewhat higher proportion of protein in her ration than is contained in the usual farm-grown feeds in Ohio.

Since the roughage crops grown vary to a marked degree in protein content, the amount of protein actually needed in addition to the home-grown feeds will vary widely according to the kind and quality of the roughage. Aside from the use of high-protein roughages, the most practical means of increasing the protein content of the ration is by means of high-protein by-product feeds such as cottonseed and linseed oilmeals, or the high protein grain mixtures recently introduced on the market.

While it is a matter of common observation as well as experiment that the use of these high-protein products in the grain mixture tends to increase milk production, it is also true that in Ohio, as in other states in or near the region where surplus corn and oats are produced, the extensive use of these high-protein products adds greatly to the cost of the grain mixture, hence to the cost of feeding. Under such conditions it is necessary to strike a proper balance between the value of the increased production and the increased cost of feeding to secure maximum returns.

Experiments designed to answer the question, "How much of these high-protein products should be included in the grain mixture for greatest net returns?" were conducted during the two winter periods of November, 1928 to April, 1929, and November, 1929 to April, 1930, inclusive. The roughage raised at this farm and used in the experiments consisted of a good grade of mixed hay and well-matured corn silage. These were fed to all cows alike at the rate of approximately 10 pounds of hay and 30 pounds of silage daily.

Two grain mixtures containing respectively 10 per cent and 30 per cent of high protein supplement (equal parts of choice cottonseed meal and linseed oilmeal) were compared. Each grain mixture consisted chiefly of equal parts of corn-and-cob meal and ground oats, and each contained 10 per cent of wheat bran. The

[1]This work was done at the Hamilton County Experiment Farm, Mt. Healthy, Ohio. Mr. W. E. Weaver was in charge of the work at the farm.

one grain mixture contained 19 per cent total or 16 per cent digestible protein; the other 13.8 per cent total or 10.9 per cent digestible protein. The higher protein ration supplied approximately as much protein as called for by the Haecker Standard; the other, about 75 per cent as much.

The Jersey herd of about 16 cows was divided into two groups as nearly equal as possible in all respects. These groups were alternated in reverse order on the respective grain mixtures by six-week periods during the first winter; and by periods of two months each during the second winter.

TABLE 1.—Grain Mixtures Compared

	13.8 per cent protein mixture	19 per cent protein mixture
	Lb.	*Lb.*
Ground ear corn	400	300
Ground oats	400	300
Wheat bran	100	100
Cottonseed meal	50	150
Linseed oilmeal	50	150
Total mixture	1000	1000

The cows were weighed on two successive days at the beginning and at the end of each experiment; also, each time the rations were reversed. Numerous live-weight fluctuations were observed but the net gains or losses on the two rations were not greatly different and there was no noticeable difference in the condition of the cows in the respective groups.

Records were kept of the prices paid for all purchased feeds, and estimates on the local prices of the hay, silage, and home-grown grains were also made and recorded at regular intervals. Some price variations were noted, but the average price level prevailing during the two experimental periods was practically the same, so that the same values as shown in Table 2 have been used in our calculations for both groups. We believe they are typical and will approximate the price conditions prevailing under normal conditions on many Ohio farms. All production has been calculated to the basis of 4 per cent milk by use of the Gaines' formula,

$$\text{Fat Corrected Milk} = .4 \text{ milk plus } 15 \times \text{fat}$$

During the first winter, 1928-1929, the experiment covered 644 cow days on each ration. Many of the cows freshened during the early part of the experiment; hence their records for the first two 45-day periods were not comparable and were not included in this

study. The comparison for the remaining cows for the first two 45-day periods showed a slightly higher production on the 19 per cent protein grain, but the value of the increased production lacked several dollars of paying for the extra cost of this grain. In comparing the last two periods of this experiment, when the records of the recently freshened cows were included, the results were decidedly different, showing a greater profit while feeding the higher protein grain mixture.

TABLE 2.—Prices Used to Calculate Cost

	Per 100 lb.	Per ton
	Dol.	*Dol.*
Ear corn	1.28	25.60
Oats	1.25	25.00
Wheat bran	1.90	38.00
Cottonseed meal	2.60	52.00
Linseed meal	3.40	68.00
Grinding and mixing	.15	3.00
19 per cent protein mixture	2.00	40.00
13.8 per cent protein mixture	1.65	33.00
Mixed hay	.75	15.00
Corn silage	.30	6.00
Milk (4 per cent fat)	2.60	....

A summary of all the comparable data of the 1928-29 experiment is given in Table 3. The table shows a net return $13.47 greater from the 19 per cent than from the 13.8 per cent protein mixture.

TABLE 3.—Comparison of Net Returns on the Low Protein and on the High Protein Grain Mixtures. First Year*

Feed consumed	13.8 per cent protein mixture		19 per cent protein mixture	
	Lb.	Value	Lb.	Value
		Dol.		*Dol.*
Mixed hay	6,440	48.30	6,440	48.30
Corn silage	19,073	57.22	19,073	57.22
Grain	4,935	86.87	4,799	101.27
Total cost	....	192.39	....	206.79
Milk produced (4 per cent fat)	15,345	398.97	16,417	426.84
Net returns	....	206.58	....	220.05
Difference in favor of high protein	....	....	....	13.47

*The term Net Returns as used in this article means in reality Returns Above Feed Cost, since other costs were not considered.

A comparison is given in Table 4 of the records of 6 cows in later lactation, producing an average of 20 pounds of 4 per cent milk per day for 414 cow-days on each ration, with the records of 5 other recently fresh cows, producing 30 pounds or more of 4 per

cent milk per day for 230 cow-days on each ration. These results show $5.79 greater net returns from the low-producing cows while on the low-protein mixture; and $19.26 greater net returns from the fresh cows while on the high-protein mixture.

TABLE 4.—Comparative Net Returns from 6 Cows in Later Lactation and 5 Fresh Cows

	13.8 per cent protein mixture Value Dol.	19 per cent protein mixture Value Dol.
6 cows in later lactation		
Value of milk produced (4 per cent fat)	241.81	242.80
Cost of feed	118.17	124.95
Net returns	123.64	117.85
In favor of low protein	5.79	
5 fresh cows		
Value of milk produced (4 per cent fat)	158.09	184.97
Cost of feed	72.22	81.84
Net returns	83.87	103.13
In favor of high protein		19.26

The conclusion seems justified that the fresh, heavier-producing cows made much better use of the additional protein in the 19 per cent mixture than the other group and that, at the schedule of prices prevailing at that time, the 13.8 per cent mixture was more profitable with the lower-producing and the 19 per cent mixture with the fresh cows at a higher level of production. Moreover, the data are sufficiently decisive in both instances to require a most radical change in price relations to affect the direction of the results.

The same plan was used for the second experiment except that the comparisons were made for three periods of two months each. A summary of the results of this experiment is given in Table 5.

The data of this experiment did not lend themselves to so ready a comparison of the efficiency of the two grain mixtures with cows at different stages of lactation or different levels of production. The results as combined in Table 5 show a relatively small difference, 1.9 per cent, in net returns, favoring the 19 per cent grain mixture at the scale of prices used. With such a relatively small difference in results between the two rations it is evident that price variations of the magnitude which frequently occur under

TABLE 5.—Comparison of Net Returns on the Low Protein and on the High Protein Grain Mixtures. Second Year

Feed consumed	13.8 per cent protein mixture		19 per cent protein mixture	
	Lb.	Value	Lb.	Value
		Dol.		*Dol.*
Mixed hay	7,340	55.05	7,340	55.05
Silage	24,699	74.10	24,470	73.41
Grain	6,897	113.80	6,893	137.86
Total feed cost	....	242.95	....	266.32
Milk produced (4 per cent fat)	20,019	520.50	21,124.9	549.25
Net returns		277.55		282.93

ordinary conditions could easily reverse the advantage shown for the 19 per cent mixture in this experiment to favor the lower-protein ration.

EFFECT OF PRICE CHANGES

In view of this and of the radical price changes which have occurred within recent months, we have analyzed these figures from the 1929-30 experiment by varying the price of one commodity at a time, keeping the prices of all the others at the same level as stated in Table 1. The effect of varying prices of a commodity on the net returns is shown in Tables 6, 7, 8, and 9, and in the accompanying comments.

TABLE 6.—Effect of Fluctuation in Price of Milk on Net Returns

Price of 4 per cent milk per 100 lb.	Net returns	
	13.8 per cent protein mixture	19 per cent protein mixture
Dol.	*Dol.*	*Dol.*
1.60	77.35	71.68
1.90	137.41	135.05
2.10	177.45	177.30
2.40	237.51	240.68
2.70	297.57	304.05

At $2.10 per cwt. for 4 per cent milk the net returns were nearly equal. At lower prices the 13.8 per cent mixture, and at higher prices the 19 per cent mixture, was more economical.

TABLE 7.—Effect of Fluctuation in Price of High-Protein Supplement on net Returns

Price of protein supplement per 100 lb.	Net returns	
	13.8 per cent protein mixture	19 per cent protein mixture
Dol.	*Dol.*	*Dol.*
2.60	280.32	291.21
3.00	277.55	282.93
3.40	274.80	274.65
3.80	272.03	266.38

When the price of the high-protein supplement (averaging 38 per cent protein) exceeds $3.40 per cwt. the 13.8 per cent protein mixture leads in net returns.

TABLE 8.—Effect of Fluctuations in Price of Corn and Oats on Net Returns

Price of corn and oats per 100 lb.	Net returns	
	13.8 per cent protein mixture	19 per cent protein mixture
Dol.	*Dol.*	*Dol.*
.80	303.07	302.23
1.00	292.03	293.96
1.20	281.00	285.69
1.40	269.96	277.42
1.60	258.93	269.15

The price of mixed corn and oats would need to fall to about 90 cents per cwt. before its influence alone would cause the 13.8 per cent mixture to be the more profitable.

TABLE 9.—Effect of Fluctuations in Prices of Hay and Silage on Net Returns

Price per ton		Net returns	
Hay	Silage	13.8 per cent protein mixture	19 per cent protein mixture
Dol.	*Dol.*	*Dol.*	*Dol.*
10	4	320.60	325.75
20	8	234.50	240.11
30	12	148.40	154.47

Changed prices of hay and silage affect both rations to the same extent, since the same amounts were fed in each case. However, the figures show in a striking way the importance of a good supply of reasonably priced roughage for economy in milk production.

It is very evident that prices, especially those of milk and of the high-protein grains, play an important part in deciding which of these rations would be more profitable to use at any given time or place.

The combined results of the 1928-29 experiment were $13.47, or about 6.5 per cent, in favor of the 19 per cent grain ration at the price schedule followed, rather than $5.38, or about 2.5 per cent, as was the case in the 1929-30 experiment.

It would require a decidedly radical price upset to affect the direction of the results on the basis of the massed data from the 1928-29 experiment.

It has long been recognized that the amount of protein fed in the grain should be varied more or less in accordance with the quality and protein content of the roughage fed. The results indicate that it may also be a matter of considerable importance to furnish the fresh cow and the naturally high-producing cow with a more liberal supply of protein than can be profitably used by cows in late lactation, or by those of lower productive capacity.

TABLE 10.—Suggested Levels of Protein Feeding

Kind of hay used with or without silage in limited amounts	High protein products to use in grain mixture	Total protein content of mixture
	Per cent	*Per cent*
Clover, alfalfa, or soybean hay	10 to 20	13 to 16
Mixed hay	20 to 30	17 to 20
Mostly timothy or corn stover	30 to 40	19 to 22
On good pasture	0 to 10	11 to 14

These results also show that price relations, particularly the price received for the milk and the price which must be paid for the high protein products, or rather the premium which must be paid for the latter above the price of other grains, may have a pronounced influence on the level of protein feeding which is most profitable.

What, then, is our recommendation regarding the level of protein feeding which should be followed under normal Ohio price conditions? We are presenting such a recommendation in Table 10 with the full understanding that not all the various steps have been arrived at by our own experiments described above.

Heavy producing cows or fresh cows should be given a higher protein grain mixture than low producers or strippers.

If the amount of hay is limited and stover is also fed, or if silage is fed in unusually large amounts, the proportion of high protein materials should be increased about 5 to 10 per cent above these amounts.

Low prices for milk and relatively high prices for the protein supplements call for lower levels of protein feeding, while the reverse of these conditions would favor a more liberal use of protein.

CARNATION RUST

PAUL E. TILFORD

The rust disease of carnations is found wherever the carnation is grown. The fungus, *Uromyces caryophyllinus*, the cause of the disease, is a native of southern Europe. It was first noticed in this country in 1891; very soon after its appearance it was present in almost every carnation greenhouse. Propagating stock, shipped from one section to another, was responsible for its rapid spread.

When carnation rust first appeared in this country it was thought to be a very serious disease and a real menace to the carnation-growing industry. It was later found, however, that it could be controlled to the extent that it was almost harmless to the crop. The importance and effectiveness of the various practices used in combatting rust have caused much argument among carnation growers, and therefore some experiments were conducted at the Ohio Experiment Station on the control of this disease. The results of these tests are given in the following paragraphs.

SYMPTOMS AND CAUSE

The characteristic yellowish-brown pustules of the rust on the leaves and stems (Fig. 1) make its diagnosis easy and its confusion with any other carnation disease unlikely. These pustules are caused by numerous rust spores forming below the epidermis of the leaf and breaking thru. The spores are splashed to other plants in watering. It only takes a few hours for a spore to germinate and infect a plant if the spore is lying in a drop of water on a carnation leaf or stem. After the fungus once gets inside the

plant it grows thru the tissue, breaks down the cells, and in from two to four weeks, depending on conditions, forms a new crop of spores which break thru the epidermis and form the rust pustules.

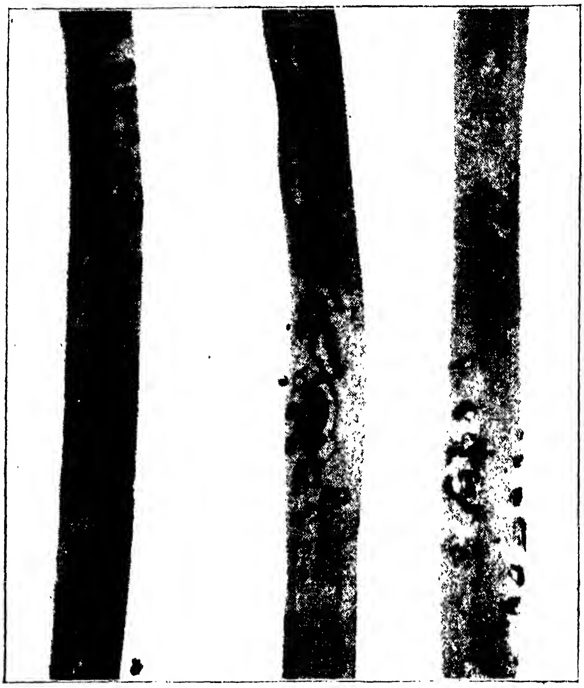


Fig. 1.—Rust pustules on carnation leaves

Individual leaves may be killed by the disease, or whole plants, if they become heavily infected, may be injured to the extent that they are unprofitable.

VARIETAL SUSCEPTIBILITY

The different varieties of carnations show a great difference in susceptibility to rust. During the spring of 1929 representatives of most of the commercial varieties were uniformly inoculated with rust spores and placed under conditions favorable for infection to occur. After a month these plants were examined and arranged in order of their susceptibility to rust (Table 1).

USE OF FUNGICIDES

Since the appearance of carnation rust there has been much argument as to the value of fungicides in controlling the disease. Bordeaux mixture has been used by growers with varying degrees

of success. Dilute solutions of copper sulfate have also been used. On the other hand, the sulfur compounds are claimed by others to be more effective than the copper sprays.

TABLE 1.—Susceptibility of Carnation Varieties to Rust

Very susceptible	Medium susceptible	Slightly susceptible	Resistant*
Betty Lou	Early Rose	Scepter	Pink Abundance
Early Dawn	Super Supreme	Maine Sunshine	Ivory
Harvester	Beacon	North Star	Donald
Enchantress Supreme	Akehurst	Pink Delight	White Matchless
	Boston Ward	Dark Rose	Fairy Queen
	Jewel	Morning Glow	Eldora
	Pink Matchless	Sophelia	Pink Eldora
	Matchless	Red Matchless	Golden Glow
	Radiolite	Spectrum	
		Winsom	
		White Ward	
		White Eldora	
		Jones	
		Hilda	
		C. W. Ward	

*Resistant does not mean totally immune.

Since the carnation leaves are coated with a waxy bloom to which sprays will not adhere, a good spreader must be used to get a satisfactory covering of any spray. Soap solutions are commonly used as spreaders; one ounce of soap chips to a gallon of spray works very well. Potash-fish-oil soap is also a very satisfactory spreader when used at approximately the rate of 1 ounce, or 2 tablespoonfuls, to a gallon of spray. Derrisol, a proprietary insecticide, when used in conjunction with sprays for carnations, is an excellent spreader.

TABLE 2.—Control of Rust in Cutting Bench by Spraying

	Lime-sulfur sprayed	Bordeaux sprayed	Unsprayed
No. cuttings set	157	140	119
No. rooted	152	133	116
Per cent rooted	96+%	95%	97+%
No. rusty plants	0	5	73
Per cent of rusty plants	0%	3.7%	62+%

In the spring of 1930 three lots of cuttings of the variety Mrs. C. W. Ward were set in the cutting bench. One lot was thoroly sprayed with 4-6-50 bordeaux plus Derrisol, a second lot was sprayed with dry lime-sulfur (1 oz. to 1 gal.) solution plus Derrisol, and the third or check lot was left unsprayed. All three groups were then sprayed with a heavy suspension of rust spores. When the rooted cuttings were removed from the sand the number of rust-infected plants was noted (Table 2).

During the fall of 1929 and the winter of 1930 experiments were conducted, in cooperation with W. W. Wiggin of the Horticulture department, to compare the effectiveness of lime-sulfur and bordeaux under commercial growing conditions. Two benches of C. W. Ward carnations containing 728 sq. ft. were divided thru the middle and one-half sprayed with bordeaux, the other half with lime-sulfur solution. Derrisol was used as a spreader. Also, the bench devoted to testing varieties was divided and treated in the same manner. Forty varieties of carnations were grown in this bench. The sprays were put on at approximately 3-week intervals. The spray was applied with a greenhouse power sprayer at a pressure of approximately 200 pounds. Some of the varieties such as Betty Lou and Early Dawn were heavily infected with rust when they were benched, so rust spores were present. The following spring these benches were carefully inspected for rust and very few leaves were found which showed any rust in either of the sets sprayed with lime-sulfur or bordeaux. Not a single plant of the most susceptible varieties had been injured in the least by rust. The bordeaux and lime-sulfur appeared equally effective.

The question is sometimes raised as to the use of dust for carnation rust. Twenty plants were dusted with sulfur-manganar dust and 20 left untreated for a check. These plants were then heavily inoculated with rust spores and kept in a suitable environment for the rust to develop. After a month not a single rust lesion could be found on the dusted plants, but all of the untreated plants were severely infected. The use of dust as a regular commercial practice has not been tried. It seems, however, to have possibilities. Since sulfur dusts burn carnation flowers, the dust should be applied after picking rather than before.

SUMMARY OF CONTROL MEASURES

Cuttings should be free from rust. Conditions in a cutting bench are very favorable for the spread and development of rust. If cuttings must be taken from affected plants they should be sprayed after they are set in the sand.

If the plants are set in the field and they are much affected with rust they should be sprayed every 2 or 3 weeks while in the field. Pot-grown plants should also be sprayed at regular intervals before they are benched.

After the plants are benched they should be sprayed every 2 or 3 weeks. After blooming starts care should be used not to spray the blooms; spray after picking rather than before.

Either bordeaux or lime-sulfur is satisfactory as a spray. Bordeaux sticks a little better and its color blends with the natural color of the leaves so that it is not as noticeable as the lime-sulfur. On the other hand, lime-sulfur is said to be beneficial in keeping down the red spider. Bordeaux should be made according to the 4-6-50 formula, or if commercial bordeaux is used it should be mixed so that it corresponds approximately to a 4-6-50 mixture. Dry lime-sulfur at the rate of 1 ounce to 1 gallon of water or liquid lime-sulfur, 1 to 50, are the right dilutions. A good spreader must be used with either spray.

Rust spores require water to germinate; therefore, keeping the tops dry helps to control rust. In watering do not splash the tops, and when necessary to syringe select a bright day when the tops will soon dry off. When two varieties are of equal value choose the one more resistant to rust.

WATER GARDENS

ALEX LAURIE

To the uninitiated the cultivation of water plants and water lilies, in particular, seems difficult. Water lilies bear magnificent flowers, both in size and variety of color, particularly the wonderful hybrids originated in recent years. Thru the use of pools and water plants charming effects may be obtained at a small expense. Water in a small garden presents cool refreshing possibilities, mirroring the foliage of the surrounding trees and reflecting the varying tints of the sky above.

Pools for water plants may be designed to fit into the architectural scheme and as such may be strictly formal with a definite coping and geometric lines, or they may be built in connection with an informal setting or at the base of a rockery. Under such conditions informality of design must be borne in mind and the outline as well as the edges should be obviously natural. The informal pools may be made of clay or concrete. Those of formal design lend themselves well to concrete construction where walls are perpendicular and the bottom a base of concrete. However, it is quite possible to use clay bottoms even in formal pools. Clay has the advantage of presenting easy possibilities for enlargement; while

concrete makes a water tight container which should present little trouble. A leaky pool necessitates continuous flow of fresh water which may be too cool for many of our tropical subjects.

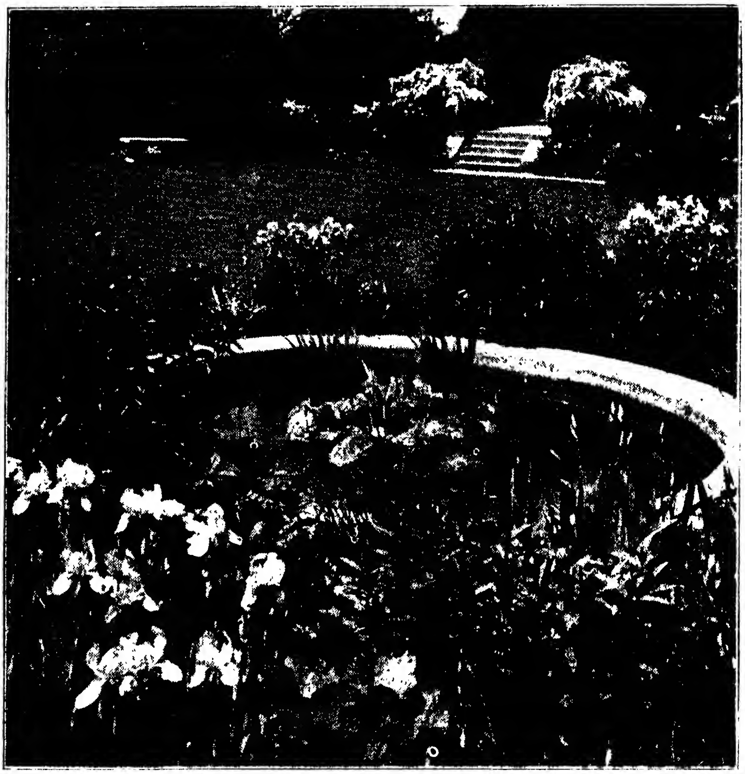


Fig. 1.—A small but interesting water effect

Where the subsoil is clay the excavation should be made about 18 to 24 inches deep and filled with rich garden loam mixed with one-third manure, to a depth of 12 inches. In this soil the lilies and other aquatics may be planted. If, however, it is desired to build a concrete pool, the plants are then set out in tubs and transferred to the ponds when the weather permits. Saucer-shaped concrete pools are easy to construct, using heavy chicken wire for reinforcement with a mixture of one part cement, two parts sand, and three parts gravel. A thickness of four inches is desirable at the bottom and at least six inches in the walls.

After the initial filling of the pool, it requires but a small stream to keep the water fresh and clean. It is necessary to prevent scum from accumulating on the surface of the water, as well

as to reduce the danger from mosquito breeding. If a half-inch stream of water be allowed to run slowly into the pool, the slight over flow will usually carry off any scum which may accumulate. If unsightly scum does appear, copper sulphate may be used on the surface as a spray made by dissolving it at the rate of 1 ounce to 20 gallons of water or by placing copper sulphate in a bag and dragging it back and forth over the surface.

The smallest water garden may be made of a tub sawed in two, filled with soil to within about 1 foot of the rim, and planted with several aquatic plants. If the rim is sunk below the surface of the soil or hidden by rocks or plants, the effect is very pleasing amidst natural surroundings. Two or three such little water gardens may be grouped together. Sometimes it becomes desirable to make a series of pools of varying sizes and depths. They may then grade from the marsh plants to the floaters and shallow water kinds.

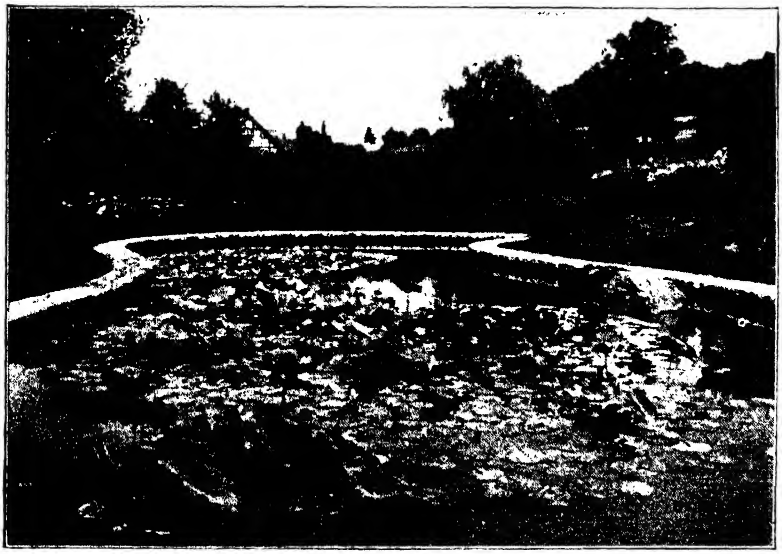


Fig. 2.—A large pool in an informal setting

Water lilies may be divided roughly into two classes—the tender and the hardy. The tender tropical lilies are the most striking and at least one or two varieties should grace a pond. They are difficult to propagate unless facilities for heating water in tanks during the winter are available. It is best to buy new plants each year; these should not be planted out until the water temperature reaches about 65° or 70° which usually occurs about the middle of June. A box or tub 2 to 3 feet square should be used for each

plant, spaced in the pool about five feet apart to allow for proper development and also leave sufficient water surface for effect. At least six inches of manure should be placed in the bottom of each tub. At first, water to a depth of 3 or 4 inches is advisable; later, as leaves develop, ten to twelve inches of water may be found desirable.

In addition to the water lilies, the lotus is frequently used, but care should be exercised in its introduction to the pool since its root growth per season is enormous and it soon encompasses the entire pool to the exclusion of all other vegetation. If used, the roots should be confined by a wall or boxed in. Often aquatic plants are introduced into the pools to add grace to the setting; many native and exotic plants serve this purpose. Eel grass, Sagittaria, cat tails, Thalia, and Elodea are suitable objects for planting at the edges in a naturalistic setting.

COMMERCIAL FEEDS SOLD IN OHIO

V. R. WERTZ

There has been much interest in the extent of commercial feeds sold in Ohio. This year, for the first, an effort was made to secure from feed manufacturers the quantity of commercial feeds sold in Ohio. Schedules were sent to 421 feed manufacturers licensed[1] to sell feeds in Ohio in 1929. To date, estimated tonnages have been received from 243, or 58 per cent of these firms. The total tonnage of the various kinds of feeds reported by these 243 firms is given in the following table.

TABLE 1.—Commercial Feeds Sold in Ohio in 1929 as Reported by 243 Feed Manufacturers Licensed to Sell Feeds in Ohio

	Tons	Per cent
Dairy feeds	129,358	18
Poultry feeds	174,244	24
Hog feeds	20,242	3
All other mixed feeds	49,361	7
Miscellaneous feeds, such as bran, middlings, tankage, alfalfa meal, etc.	351,048	48
Total	724,253	100

[1]Those manufacturers selling feeds in Ohio are required by law to be licensed by the State.

The total in this table, 724,253 tons, cannot be regarded as the total tonnage sold in Ohio in 1929, but is probably well above 58 per cent of the total, for those reporting included most of the larger feed companies and undoubtedly many of those who did not return their schedules failed to do so because they had little or no Ohio tonnage to report.

Of the 243 firms reporting sales, 182 gave their estimated tonnages sold in Ohio in 1928 as well as in 1929. The combined tonnages of these 182 firms are given in the following table.

TABLE 2.—Commercial Feeds Sold in Ohio in 1928 and 1929 as Reported by the Same 182 Feed Manufacturers in These Two Years

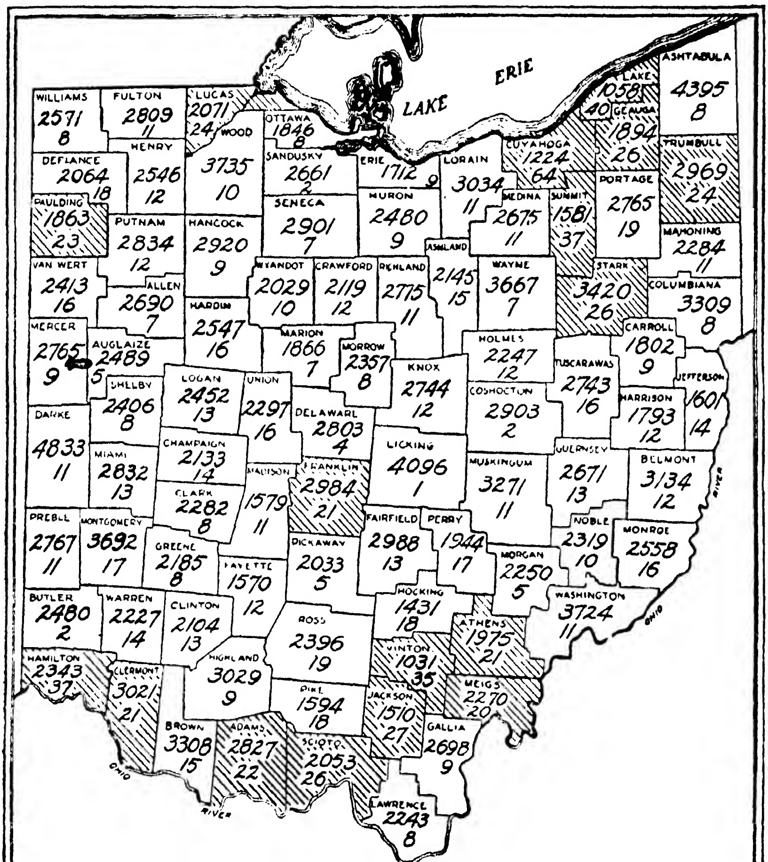
	1928		1929	
	Tons	Per cent	Tons	Per cent
Dairy feeds	116,078	18	120,292	18
Poultry feeds	134,955	21	159,594	24
Hog feeds	20,203	3	19,024	3
All other mixed feeds	41,523	7	39,333	6
Miscellaneous feeds, such as bran, middlings, tankage, alfalfa meal, etc.	329,342	51	324,300	49
Total	642,101	100	662,543	100

This table is of interest because of the comparisons which it shows between 1928 and 1929. The total tonnage increased 3 per cent from 1928 to 1929. The principal gain was in "poultry feeds", the quantity of "poultry feeds" increasing 18 per cent from 1928 to 1929. Poultry feeds amounted to 21 per cent of the total amount of commercial feeds sold in Ohio in 1928 and 24 per cent in 1929. There were slight decreases in the quantity of "hog feeds", "all other mixed feeds", and "miscellaneous feeds" sold in Ohio in 1929.

DECREASE IN NUMBER OF OHIO FARMS

J. I. FALCONER

The 1930 Census reports a 14.4 per cent decrease in the number of farms in Ohio since 1920. The 1920 census reported 256,695 farms in the State, that of 1930 only 219,659 farms. Every county reported a decrease in the number of farms ranging from 63.7 per cent decrease in Cuyahoga County to 1 per cent in Licking County.



Seventeen counties reported decreases of 20 per cent or over. In this group are the counties having large cities such as Cuyahoga, Hamilton, Lucas, Franklin, Summit, Stark, and Trumbull, also, Lake and Geauga, where the Cleveland suburban movement has taken many farms out of use. Several southeastern Ohio counties,

namely, Vinton, Jackson, Scioto, Adams, Clermont, Athens, and Meigs, are in the rougher land area of Ohio, and apparently much of the decrease in the number of farms in this area is due to the poorer land going out of agricultural use. Paulding County in the northwest part of the State showed a decrease of 23 per cent in the number of farms. However, Paulding County farms have been growing larger in size, hence this decrease in number of farms has been accompanied by an increase in the average acreage per farm.

The above three factors, namely, the expansion of city areas, the going out of agricultural use of much land in the poorer areas, and the enlargement in size of farms, are probably the leading factors causing the decrease in number of farms during the past ten years.

In the accompanying map the upper figure within each county boundary is the number of farms reported in 1930. The lower figure is the per cent decrease in number of farms from 1920 to 1930. Those counties showing a 20 per cent or greater decrease are shaded.

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

During the period from January to July, 1930, wholesale prices in the United States declined 10%, United States farm product prices 28%, and Ohio farm product prices 18%. In July, Ohio farm product prices were at as low a level as at any time since the war. The slight rise in August was due largely to higher prices received for milk.

During the first eight months of 1930 the cash income from the sales of farm products for the State was 19½% below that of the corresponding period of 1929. For the twelve months ending in August 1930 the income was 12% below that of the preceding twelve months.

Trend of Prices and Wages, 1910-1914=100

	Wholesale prices all commodities U. S.	Weekly earnings N. Y. State factory workers	Prices paid by farmers for commodities bought U.S.	Farm product prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm product prices	Ohio cash income from sales
1913	102	....	100	100	104	100	105	100
1914	100	100	101	102	102	102	105	107
1915	103	101	106	100	103	107	106	110
1916	130	114	123	117	113	113	121	121
1917	181	129	150	176	140	119	182	198
1918	198	160	178	200	175	131	203	243
1919	210	185	205	209	204	135	218	266
1920	230	222	206	205	236	149	212	242
1921	150	203	156	116	164	134	132	136
1922	152	197	152	125	145	124	127	136
1923	156	214	153	135	166	122	134	149
1924	152	218	154	134	165	118	133	150
1925	161	223	159	146	165	110	159	164
1926	154	229	156	136	170	105	155	176
1927	149	231	154	131	173	99	147	163
1928	153	232	156	139	169	96	154	147
1929	151	236	155	138	169	94	151	161
1929								
January	152	234	156	133	166	....	144	149
February	151	236	156	136	....	....	149	143
March	153	239	156	140	....	94	155	151
April	152	237	155	138	163	....	150	150
May	150	236	155	136	....	....	152	147
June	151	236	155	135	....	....	153	160
July	154	235	154	140	172	....	157	207
August	153	237	154	143	....	....	159	187
September	153	240	154	141	....	....	153	171
October	151	237	154	140	174	....	151	162
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NEW MONOGRAPH BULLETINS NOT PREVIOUSLY ANNOUNCED

No. 454. Raspberries and Blackberries in Ohio, J. S. Shoemaker. This bulletin contains probably the most complete available information of value to growers of brambles. Not only does it discuss in considerable detail the operations involved from planting to harvesting, but, included under culture, is information relative to the selection of a site, methods of propagation, and the characteristics of numerous varieties.

Diseases are classified and discussed under four headings—those affecting the entire plant and usually resulting in death; those affecting the entire plant and causing varying degrees of stunting; those primarily affecting the canes; and those primarily affecting the leaves. Insect pests of brambles are discussed under fruit and foliage feeders, and insects affecting stems and roots.

Many illustrations are used to point out various cultural practices and to aid in identifying the work of different diseases and insect pests.

No. 455. Dicalcium Phosphate as a Mineral Supplement for Dairy Cows, C. C. Hayden, C. F. Monroe, and C. H. Crawford. The experiment reported in this bulletin extended over a period of 5 years and 11 months and, therefore, afforded ample time for any long-time effect of the mineral supplement to become apparent. No significant difference in milk production was found between the group of cows receiving dicalcium phosphate and the control group. None of the beneficial effects on health popularly attributed to minerals were observed; cases of abortion, sterility, and retained placenta occurred in both groups.

In the opinion of the authors, "When rations containing legume hays and a grain mixture containing bran and linseed oilmeal or cottonseed meal are fed, cows probably will not be benefited by the addition of dicalcium phosphate. In general, when rations of the above type are fed, mineral deficiencies probably do not exist."

In addition to presenting the data and results of this experiment, a good general discussion of the mineral feeding problem as related to dairy cattle is included.

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[1]In cooperation with College of Agriculture, Ohio State University.
[2]In cooperation with the U. S. Department of Agriculture.

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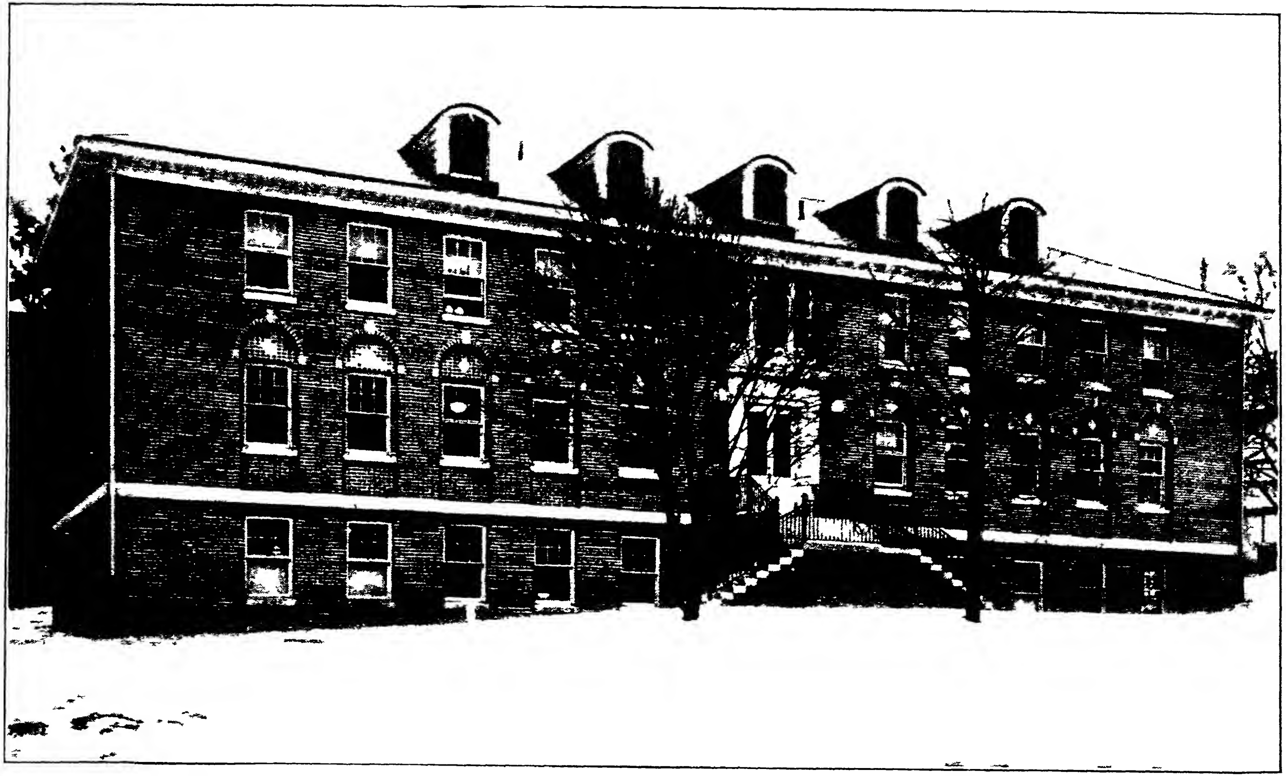

The new Animal Industry building at the Ohio Agricultural Experiment Station

CORN SILAGE VERSUS A MIXTURE OF WET BEET PULP AND MOLASSES FOR MILK PRODUCTION

C. F. MONROE, C. C. HAYDEN, AND A. E. PERKINS

Some form of succulence in the dairy ration is generally considered desirable. The feed most frequently used to supply succulence is corn silage, because of its cheapness and (commonly accepted) general merit. As corn silage is not available on many farms, owing to the fact that the herds are too small to warrant a silo, a substitute for silage must be used if succulence is to be had in the ration. Even on farms with silos there are sometimes intervals in the fall and spring when corn silage is not fed, usually because of insufficient supply. In many of these cases, the succulence has been furnished by wet beet pulp or field beets. For feeding test cows, many dairymen prefer either of these two feeds to corn silage, largely because they believe these feeds stimulate production.

In the last few years several commercial interests have advocated succulent feeds made by chopping and milling roughages and then wetting them with water and processing in one way or another. The various recommendations for preparing this form of succulence have varied in accordance with the item for sale. One of the chief claims made is that the feeds so prepared do not contain the "harmful acids" that are present in corn silage. It has been claimed that these "harmful acids" bring about a condition of acidosis in the animal body and are conducive to breeding troubles and abortion. The validity of these claims may be questioned.

This experiment was conducted to determine the effect on some of the body reactions and on the production of milk and butterfat of substituting a non-acid succulent feed for corn silage. This article deals with the effect on production. The discussion of the effect of corn silage on body reactions is the subject of the following article.

Wet beet pulp flavored with blackstrap molasses was the silage substitute used. This mixture is quite similar in chemical composition to corn silage except that it does not contain the acids. The molasses, which made up less than 5 per cent of the wet mixture, was added to increase the palatability of the mixture. This may not have been necessary but it was considered desirable as some of the cows were to be fed quite heavily on this feed—some

of them actually consumed over 40 pounds a day of the mixture. This should not be misconstrued to mean that in order to get cows to eat beet pulp it is necessary to flavor it with molasses. After cows become accustomed to wet beet pulp they eat it with apparent relish. The cows in this experiment had not been so trained.

Sixteen cows were used in this experiment, divided into groups as follows:

Group I.—Two mature Jerseys, advanced in lactation, were fed silage for 50 days and then the wet pulp mixture through the dry period until freshening.

Groups II and III.—Four Jerseys and one Holstein in each group were fed silage for 100 days and beet pulp for 50 days. These two groups were alternated in the last 100 days of the experiment. Groups II and III were the ones used in the milk and fat production comparison.

Fig. 1.—Group 2 produced 4,336.8 pounds of 4% milk on the beet pulp ration, and 4,146.9 pounds on the corn silage ration

Group IV.—Four fresh cows were fed extremely large amounts of the two succulent feeds for various lengths of time, depending upon the freshening date.

The wet beet pulp-molasses mixture was made by adding 2 pounds of blackstrap molasses to every 10 pounds of dried pulp and then mixing with 30 pounds of water. This was made up each day several hours before feeding. The corn silage fed during the larger part of the test was of average good quality. Although it became necessary for a time to feed silage of a supposedly inferior quality, this change in silage did not apparently adversely affect production. The cows receiving this silage produced 9 pounds

more milk after the change than they did before, in a corresponding period of 30 days. Alfalfa hay and the same grain mixture were fed to all the cows throughout the experiment.

The individual Jersey cows in Groups I, II, and III received, daily, 20 pounds of the succulent feed (the Holsteins, 24 pounds), 14 pounds of hay, and what grain they would eat readily, which ranged from 8 to 12 pounds. The cows in Group IV received all the succulence they would eat, which varied from 30 to 52 pounds; the average was about 40 pounds. The hay fed to this group was reduced to 10 or 11 pounds daily. About 10 pounds of grain were fed each day. The cows showed marked eagerness for the beet pulp-molasses mixture, which would indicate that this preparation was quite palatable.

MILK AND BUTTERFAT PRODUCTION

In the study of the effect of these two succulent feeds on production, only ten of the 16 cows have been considered. These were the cows in Groups II and III, the only ones in the proper stage of lactation to continue through the entire 150 days of the experiment in normal milk flow. During the first 50 days, or period 1, both groups were fed alike on corn silage, alfalfa hay, and the same grain mixture. At the end of this time, Group II was changed to the wet beet pulp-molasses mixture, this being the only variation made. Group III continued as in period 1. In the third period of 50 days, Group II was returned to the original silage ration, and Group III was given the beet pulp-molasses mixture.

Fig. 2.—Group 3 produced 4,869.0 pounds of 4% milk on silage ration, and 5,152.5 pounds of 4% milk on beet pulp ration

Table 1 lists the supplements fed to the two groups in the different periods. This table also gives the productions and live-weight averages for the groups in the various periods. The results

as given refer to periods of 40 days in length, the first 10 days' results of each period being omitted.

A brief analysis of Table 1 will show in a qualitative way how production was affected by these two supplements. In period 2 the cows (Group II) which were changed to the beet pulp mixture increased slightly in milk production but owing to a decrease in butterfat test gave practically the same amount of butterfat as they did in the preceding period, when they were receiving the corn silage. At the same time, the cows in Group III, which were receiving the silage as usual, decreased slightly in milk, but their increase in butterfat test kept the total butterfat production the same as in the preceding period.

TABLE 1.—Silage vs. Beet Pulp-Molasses for Milk and Fat Production
Groups II and III—40-day periods

Supplement	Period 1	Period 2	Period 3
	Silage	Wet beet pulp-molasses	Silage
Group II			
Milk, lb.	3660.3	3739.0	3536.9
Fat, lb.	188.84	189.41	181.47
4 per cent milk, lb.	4296.8	4336.8	4146.9
Test, per cent	5.16	5.07	5.13
4 per cent milk per 100 lb. dry matter, lb.	83.9	85.4	81.9
Average liveweight, lb.	1008.0	1032.0	1065.0
Group III			
	Silage	Silage	Wet beet pulp-molasses
Milk, lb.	4088.5	3992.1	4492.0
Fat, lb.	218.67	218.2	223.71
4 per cent milk, lb.	4905.6	4869.0	5152.5
Test, per cent	5.35	5.47	4.98
4 per cent milk per 100 lb. dry matter, lb.	91.1	90.9	95.1
Average liveweight, lb.	937.0	968.0	1004.0

In period 3 when the two groups were reversed, Group II, which was changed to the silage supplement from the beet pulp mixture, declined in milk and in fat production. The increase in fat test was not sufficient to keep the total fat production up. At the same time the opposite change in supplements for Group III, or from silage to beet pulp, resulted in an increase in milk and butterfat, although there was a marked decrease in fat test.

In Table 1 figures are also given for the production of 4 per cent milk. By the use of this term it is possible to combine the total energy output in milk and butterfat into one figure. This

figure is obtained by multiplying the pounds of milk by 0.4 and adding this result to the pounds of fat multiplied by 15. The expression so derived is commonly called "Fat-Corrected Milk". Reviewing Table 1 for this item, it will be seen that the production of 4 per cent milk was the greatest for both groups in the beet pulp-molasses periods. In the case of Group III, the cows were producing more at the end of the experiment on this silage substitute than they were at the beginning, 150 days earlier, when they were receiving the corn silage. The production of 4 per cent milk per 100 pounds of dry matter consumed was also highest during the beet pulp-molasses periods.

Inspection of the data for the individual cows on these rations shows the same general tendency as described above. In other words, these results were not unduly influenced by one or two individuals.

TABLE 2.—Silage vs. Beet Pulp-Molasses for Milk and Fat Production
Groups II and III—Total production

Ration	Am't. fed	Milk	Fat	4% milk	4% milk per 100 lb. dry matter	Average test	Live-weight
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Per cent*	*Lb.*
Beet pulp-molasses	8287	8231.0	413.12	9489.3	90.25	5.02	1018.
Corn silage	8040	7529	399.67	9015.9	86.4	5.31	1016.5
Difference*	....	+702	+13.45	+473.4	+3.85	— .29	+1.5
Difference,† per cent	....	9.3	3.4	5.2	4.5	....	....

*+favors beet pulp-molasses; —favors silage.
†Production on silage considered as base, or 100 per cent.

In Table 2 the total productions are given for the two rations. These figures show that, in general, there was increased production when the cows were on the beet pulp-molasses feeding. However, the average tests were higher on the silage feeding. This materially reduced the difference in butterfat production which would have followed if the per cent of fat had not dropped in the beet pulp-molasses periods. There was practically no difference in liveweight on the two rations.

From a practical standpoint the increase in milk production from feeding the beet pulp-molasses mixture was not economical because of the increased cost of this mixture over the corn silage. On the wet basis, as fed in this experiment, this mixture cost $12 per ton[1], or twice as much as corn silage which was valued at $6 per ton. On the basis of feed consumption, the beet pulp-molasses ration cost $26 more than the corn silage ration. In return for this $26 spent there resulted 700 pounds more of 5 per cent milk; hence

[1]Dried beet pulp valued at $42 per ton. Molasses valued at $44 per ton.

the increased production did not justify the increased feed cost. In feeding cows for Registry of Merit and Advanced Registry production, this item of cost would be a secondary consideration. Also, if silage were not available or could not be produced at a moderate cost the beet pulp-molasses succulence would offer possibilities.

DOES THE FEEDING OF CORN SILAGE TO DAIRY COWS LEAD TO ACIDOSIS?

A. E. PERKINS, C. C. HAYDEN, AND C. F. MONROE

As is well known, corn silage has an acid taste and reaction due to the presence of various organic acids. The two acids occurring in largest amounts in normal corn silage are acetic acid, the characteristic acid of vinegar, and lactic acid, the predominant acid occurring in sour milk.

The total acidity of corn silage as determined by titration usually ranges between 2 and 3 per cent.

Numerous speculations are abroad regarding the effect on the cow of eating regularly, over long intervals, the comparatively large amounts of acid incidental to the liberal feeding of silage.

Certain of these speculations have been seized upon by commercial interests advocating other systems of feed preparation and have been organized into propaganda opposing the use of silage. A connection is assumed between the eating of the acids found in silage or other acid foods and the acidosis, or excess of acids, which sometimes develops in man or other animals as a result of disease or malnutrition.

THEORETICAL CONSIDERATIONS

Such an assumption seems quite unwarranted on theoretical grounds for there is good physiological evidence to show that both the lactic and acetic acids found in corn silage are normal intermediate products in the breaking down of both carbohydrates and fats as this process normally occurs in the animal body; and, this being the case, a far greater amount of these acids is doubtless formed and used in the body regularly from the large amount of carbohydrates and fats eaten than would ever be introduced by the feeding of corn silage in customary amounts. In one sense the organic acids in the silage may be regarded as sugars already

partly digested. They are probably utilized by the organism as readily as are the sugars themselves. The end products of both of these acids are simply carbon dioxide and water, both of which are readily eliminated.

Ordinarily, the reaction of the blood and urine of cattle is slightly alkaline and there are present in the blood, and also to a lesser degree in the urine, certain salts, principally bicarbonates and phosphates, which have the power of combining with excessive amounts of either acids or bases which may be present. The proper reaction of the body fluids is thus maintained, regardless of the reaction of materials which are introduced from the food or elsewhere.

Ammonia, which is usually present only in small amounts, may be formed in greatly increased amounts from the metabolism of protein materials and be used to combine with excess acids as an additional means of maintaining the proper reaction of the body fluids. The objectionable material when thus neutralized is promptly excreted in the urine so that accompanying any large excess of unused acid (acidosis), there will be found in the urine a marked decrease or even disappearance of the bicarbonates which are normally present and a marked increase in the amount of ammonium salts, which are usually present only in small amounts.

TABLE 1.—Changes in the Blood and Urine Produced by Individual Foods (Cow 56)*

Date	Blood plasma					Urine				Feeding
1920	CO_2 capacity per 100 cc.	Calcium per 100 cc.	Total phosphorus per 100 cc.	Inorganic P per 100 cc.	Liquid P per 100 cc.	Specific gravity	CO_2 per 100 cc.	Ammonia N per 100 cc.	Phosphorus per 100 cc.	
Mar. 1.	58.6	10.3	12.2	5.7	7.5	1.027	37.0	11.0	178.0	Grain only
Mar. 4.	69.2	11.3	9.6	3.9	5.7	1.030	554.0	4.0	3.0	Alfalfa hay only
Mar. 9.	54.8	10.4	9.1	3.6	5.5	1.021	4.0	13.0	54.0	Corn silage only

*Blatherwick, N. R. Jour. Biol. Chem. 42, 1920, p. 523.

A condition with respect to the bicarbonates and ammonia in the urine, similar to that occurring in acidosis, has been noted by Blatherwick, of the United States Department of Agriculture, in cattle fed for a short time on an exclusive diet of corn silage. One of Blatherwick's tables (Table 1) is reproduced for purposes of comparison with our own data. Blatherwick also obtained very low bicarbonate and high ammonia values by exclusive grain feeding so that it is felt that this condition should be attributed to a

lack of balance in the mineral intake rather than to the organic acids eaten with the silage. The determinations of calcium and phosphorus in these and other samples of urine reported by Blatherwick would lend support to this explanation. Exclusive hay feeding, especially hay from the legumes, showed the opposite tendency of increasing the amount of bicarbonates and decreasing the ammonia content of the urine.

EXPERIMENTAL

Whatever may be our conclusions regarding the harmfulness of silage acids on purely theoretical grounds, direct experimental evidence is more convincing. In Table 2 are shown the results of urinary analyses conducted on the cows in the present experiment, some of which were heavily fed on silage while others, similarly fed in other respects, received beet pulp practically free from acids in place of silage. The details regarding the feeding and management of the cows are given in the previous article. Each figure as given is the average of at least 10, and in most cases 30 or more, individual determinations representing each of the various cows on several different dates. The samples on which the determinations were made in every case represented a 6-hour quantitative collection of urine. The various determinations were made on fresh urine or on urine which had been properly stored and preserved to prevent decomposition. It will be seen that the urine of these cows receiving 30 to 50 pounds daily of corn silage, in addition to a grain mixture and alfalfa hay in suitable amounts over long periods of time, showed no evidence pointing toward any condition resembling acidosis.

TABLE 2.—Average Analysis of Urine From Cows Fed Rations Containing From 30-50 Pounds of Corn Silage and From Others Fed Equivalent Amounts of Beet Pulp

Urines resulting from	Reaction pH	Cc. of CO_2 held as bicarbonate in 100 cc. urine	Mg. ammonia N in 100 cc.	Organic acids Cc. of normal acid in 100 cc. urine
Silage ration, average	8.20	276	1.72	31.1
Silage ration, heavy	8.10	281	2.98	30.6
Beet-pulp ration	7.62	327	1.47	27.3

The amount of bicarbonates present in the urines produced on the different rations was not greatly different. The amount in all cases may be considered normal, showing that heavy silage feeding as compared either with light silage feeding or the feeding of sugar beet pulp did not materially affect the excretion of bicarbonates in the urine. Likewise, the ammonia content of the

urine, though apparently increased somewhat on the heavy silage feeding as compared with that excreted on the other two rations, is still below the upper limit of what is a normal value for this constituent. In acidosis the amount of ammonia would probably be several times as high as observed on any of these rations.

Determinations were also made of the amount of organic acids present in these urines. This determination is particularly significant in human urine in revealing the presence of the acidosis which frequently accompanies diabetes. Aceto-acetic acid, acetone, and B-hydroxybutyric acid are chief among the abnormal ingredients of the urine measured by this determination. The normal value for this determination in bovine urine is unknown, but it is significant that the urine from the cows fed heavily on silage (corresponding to an intake of approximately 1¼ pounds of lactic and acetic acids daily), was not significantly higher in organic acids than the urine from the beet pulp-fed cows which were eating no acid.

As will be seen in Table 1 quoted from Blatherwick's article, the composition of the blood remains fairly constant in spite of the great contrasts shown in the composition of the urine. For this reason we have not considered it necessary to conduct extensive analyses on the blood.

What the result would be with other combinations of hay, grain, and silage, the present data are not sufficient to answer; but it seems clear that corn silage to the extent of 50 pounds daily, fed in connection with alfalfa hay and a grain mixture as specified in the preceding article, did not bring about acidosis in the cows. The organic acids accompanying the silage appear to have been fully metabolized and did not appear as organic acids or related compounds in the urine.

PREPARATION OF THE SEEDBED FOR OATS

L. E. THATCHER

Various methods of preparing corn stubble land for oats have been under investigation at Wooster, including: disking and plowing, followed by drilling the seed with a grain drill; drilling the seed with a disk drill without other preparation of the land; broadcasting the seed very early in the spring on the bare frozen ground; and, lastly, broadcasting the seed on plowed land and covering with a harrow. The yields of grain and straw for the several methods of preparation are given in Table 1.

In the direct comparison of disking and plowing, the oats were sown at approximately the same dates, as early as soil conditions would permit, and the yields obtained were approximately the same. For the 19-year period, the yield of oats on plowed land was only 1.1 bushels more grain and 98 pounds more straw per acre than that on the disked land.

TABLE 1.—Preparation of Seedbed for Oats (Cornstalk Ground)—Wooster

	19-year average		18-year average		11-year average		6-year average	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
	Bu.	*Lb.*	*Bu.*	*Lb.*	*Bu.*	*Lb.*	*Bu.*	*Lb.*
No preparation. Seed broadcast early. No cover	....	....	....	....	33.1	2629	22.3	2421
No preparation. Disk drill only	....	....	44.8	2682	44.8	2790	39.9	2679
Ground disked. Disk drill	52.9	2697	53.9	2755	55.5	2815	56.1	2614
Ground plowed. Disk drill	54.0	2795	54.5	2834	56.9	2967	60.7	3019
Ground plowed. Seed broadcast and harrowed in	....	....	....	....	....	....	60.4	3273

Drilling the oats without any previous preparation of the land gave an average yield for 18 years of 44.8 bushels of grain, or 9.1 bushels less than on a seedbed prepared with the disk harrow.

Broadcasting the seed early in the spring on the bare, frozen ground gave an 11-year average yield of 33.1 bushels, or 22.4 bushels less than on disked land.

Broadcasting the seed on plowed land and covering it with the harrow yielded practically the same as drilling the seed with a grain drill on prepared plowed land, in a 6-year test.

For the most part, the oats in these tests have been grown in a corn, oats, wheat, clover rotation, in which the clover sod was well manured during the winter and plowed for corn; the corn also received a liberal application of superphosphate fertilizer broadcast. The wheat received about 350 pounds per acre of a complete fertilizer, for the most part a 2-12-2 analysis. The oats have not been fertilized directly.

The soil on which these tests were located is classified as Wooster silt loam. It has a tendency to run together, pack, and crust badly following rains. Fall plowing is not practical for this reason, but very early spring plowing may be done successfully after the excess water has drained away. The soil works up easily with the disk harrow, if it is not too dry and compact.

Weeds were more troublesome in the oats on the disked land than on the plowed land, and they were very serious on the "no preparation" plots.

In a more recent test started in 1928, the attempt is being made to determine the effects of plowing and disking the land when oats are sown at various dates. The method of seedbed preparation, the dates of sowing, and the yields of grain are given in Table 2.

TABLE 2.—Plowing vs. Disking for Oats Sown at Different Dates—Wooster

1928			1929			1930		
Date of sowing	Date plowed—Apr. 13	Date disked—Apr. 13	Date of sowing	Date plowed—Apr. 24	Date disked—Apr. 24	Date of sowing	Date plowed—Apr. 15	Date disked—Apr. 15
	Bu. per acre			Bu. per acre			Bu. per acre	
Apr. 13......	27.5	38.9	Apr. 24.....	52.0	55.8	Apr. 15...	38.1	38.7
Apr. 22......	24.1	42.8	May 1.......	47.0	50.1	Apr. 22...	39.8	34.8
Apr. 27......	28.4	41.4	May 8.......	44.1	43.7	Apr. 29...	45.6	31.6
May 4........	18.6	35.1	May 15......	37.5	30.8	May 6.....	50.3	36.2
May 11	28.1	30.8	May 22......	28.7	17.0	May 13....	46.2	29.8
	Apr. 27	Apr. 27		May 15	May 15		May 6	May 6
Apr. 27......	24.5	26.2	May 15......	31.1	29.4	May 6.....	50.1	43.0
	May 11	May 11		May 22	May 22		May 13	May 13
May 11......	34.4	32.5	May 22......	21.9	17.8	May 13....	41.4	38.6

No final conclusions can be drawn until the test has been going long enough to enable one to measure the reactions to different seasonal conditions.

For the early dates of sowing, thus far, disking has given yields equally as good as, or somewhat larger than, plowing. There is some indication too that when, for any reason, the sowing date is late, plowing may be preferable to disking on the Wooster silt loam soil, in that this soil usually becomes hard and difficult to prepare well by late disking.

During the course of these experiments it has been observed that oats lodge more frequently on the plowed land, due to more favorable conditions for a heavy growth of straw. See Figure 1.

Disking for oats is a very common method of seedbed preparation in Ohio. It is usually a cheaper method and the seed can usually be sown earlier on disked land.

The comparative costs of disking and plowing the land for oats in Medina County for the 5-year period of 1920-1924, inclusive, are reported by F. L. Morison, assistant in the Department of Rural Economics[1].

[1]Morison, F. L. "Variations in crop production costs in Medina County, Ohio". Ohio Agr. Exp. Sta. Bull. 453. 1930.

"The total cost of labor and power for the production of oats, including harvesting, was $6.28 per acre for the part which was disked as compared to $9.11 per acre where the seedbed was plowed," says Mr. Morison. His data were taken from the records of five farms on which part of the seedbed was plowed and part disked. The oats on the disked land yielded 34.2 bushels per acre and on the plowed land, 31.7 bushels. The average date of sowing was April 26 for disking and May 4 for plowing; this may account for the somewhat better yields of the disked oats.

Fig. 1.—Oats in preparation of seedbed tests at Wooster, 1928—"Lodged oats on plowed land. Not lodged on disked land"

Early sowing is important and, in our experiments, even though "mudded in" on the disked land, the early sown oats have yielded higher than the late sown oats.

The desirability of disking for oats seems to be well established by experimental tests and also by the common experience of farmers. The following may be exceptional conditions where plowing may be preferable:

1. In certain sections fall and winter plowing may be done when other farm operations are not rushing. On some soils, as in northwestern Ohio, spring seeding can then be done early without any additional seedbed preparation.

2. In northeastern Ohio, where the common rotation is corn, oats, wheat, and clover, many farmers find it easier to plow for wheat if the land was spring-plowed for oats. The advantage gained in the preparation of the wheat seedbed may offset the disadvantage of plowing for oats in certain instances.

3. In sections where the European corn borer is likely to become a serious pest, a good job of plowing under corn stalks and stubble is highly desirable as a means of control.

4. On very weedy land, plowing may be one means of reducing the amount of weeds in the oats.

5. When late sowing is unavoidable, plowing may be desirable in some seasons and on certain soil types. More information is being accumulated on this point. It is probably true that more care is necessary in the preparation of the seedbed for oats as the date of sowing becomes late in the season.

Many farmers use oats as a nurse crop for alfalfa, sweet clover, red clover, and grass seed mixtures. The method of preparing the seedbed for oats may have an influence upon the stands of legumes and grasses seeded in the oats. The Station has little experimental evidence upon this point, but it is generally recognized as true that poor stands are likely to occur if the seedbed is loose and cloddy and the weather dry. From the standpoint of the clover, it is probable that more care should be taken to prepare the seedbed for oats as seeding becomes later in the spring. The ideal seedbed for clover is one that is firm and moist beneath the surface. The seed should be covered shallowly. If the soil is dry, rolling or cultipacking will hasten germination.

SUGAR BEET ROOT ROT CONTROL

H. C. YOUNG

Probably the most serious disease of the sugar beet in Ohio is the one generally called "black root". It is responsible for poor stands, often making it necessary to reseed or plant to other crops. Many growers have quit growing beets because of this disease, which has reduced the beet acreage tremendously. There seems but little doubt that the disease is on the increase and is at present a serious problem.

The parasite or parasites causing the disease are yet undetermined; possibly a number of organisms are responsible. The one usually associated with black root is *Phoma betae*; at least, it is known that this fungus is parasitic on beets and produces a blackening of the young beet root. It may attack and kill the plant before it comes through the soil; or, more frequently, the infected beets come up and linger along, some making but little

growth or dying, others completely recovering. When a beet recovers the fungus usually continues to grow slowly with it. When such beets are used for growing seed, the parasite follows up the stalk to the seed ball and then produces its spores. Consequently, few lots of seed are ever free from it. The fungus is also able to live in the soil in the absence of beets for 3 to 5 years, thus giving a double source of infection.

Other parasitic organisms that may cause black root are Rhizoctonia, Pythium, and Fusarium, though these usually cause another type of disease known as "damping off". Either one, however, may kill the plant before it comes up or, if it survives, may cause an appearance similar to black root.

The control of root-rotting organisms is difficult because they are usually inhabitants of the soil, and, under such conditions, the use of fungicides and disinfectants is economically impossible. Even if this were possible it would be necessary to disinfect the seed, a procedure that has not met with much success. The beet seed ball, being a complex, irregular structure, is difficult to free of contaminating organisms. During the past 5 years, most of the common seed-treating compounds have been used on beet seed, and only in fields where the organisms were absent were increased stands obtained.

There are left then two general methods of control of this type of soil inhabiting organisms; namely, the development of resistant varieties and the development of resistance through cultural practices. Sugar-beet breeding for a single disease factor has met with but little success though many attempts have been made. The second method has been more successful.

A study of the fungi that are responsible for the root rotting of beets has shown that the margin between susceptibility and resistance is exceedingly small. Moreover, it has been found that this margin may be increased or decreased by many factors such as climatic or soil conditions and fertilizers. Beets, growing normally under favorable moisture and temperature conditions and with properly balanced fertilizers, are almost entirely resistant to these fungi. An application of an active nitrogenous fertilizer, applied in part at seeding time and in part at blocking, has frequently saved fields of beets by increasing growth through this critical period. While such fertilizer treatments undoubtedly help control disease during average favorable seasons, they fail when growth conditions are not so favorable and in sections where disease is most prevalent.

In 1923, the Continental Sugar Company, seeing their acreage diminishing on account of root rot, began a series of fertilizer

balances hoping to find a combination that would control the disease more effectively. Another set of plots also contained common salt. At the end of 5 years the results plainly showed that the use of salt increased stand and yields and, in general, effectively reduced losses from root rot. The Company continued these tests in field experiments during 1928 and 1929 with similar favorable results. In 1930, they recommended the use of salt throughout many of their beet-growing sections.

Using the recommendations of the Continental Sugar Company, this Department in cooperation with Messrs. Bond, Hummon, and Williams, County Agricultural Agents, in Henry, Fulton, and Lucas Counties, respectively, attempted to determine further the value of salt for the control of root rot. Fields that had previously shown black root were selected for the test. The experiment was extended so as to show comparisons of salt, with and without sodium nitrate, as well as with the standard fertilizer treatment. The treatments used and the results of three of these tests are given in the table. The season was unfavorable for black root development and for the best effect of the salt and fertilizer.

TABLE 1.—Results of Sugar-Beet Tests for Black Root Control

Treatment	Borton		Bartosek		Villhauer
	Stand	Weight	Stand	Weight	Weight
	Per cent	*Tons per acre*	*Per cent*	*Tons per acre*	*Tons per acre*
Plot 1. Standard fertilizer treatment*	76.0	16.0	66.0	12.0	11.7
Plot 2. Standard fertilizer treatment + 150 lb. side-dress	69.0	15.8	72.0	12.3	12.7
Plot 3. Standard fertilizer treatment, except no nitrogen	56.0	11.2	68.0	11.5	11.0
Plot 4. Same as plot 1, except 500 lb. salt added	78.0	16.8	66.0	13.0	11.5
Plot 5. Same as plot 2, except 500 lb. salt added	78.0	18.0	72.0	13.0	15.2
Plot 6. Same as plot 3, except 500 lb. salt added	73.0	16.0	68.0	12.5	12.8

*Standard fertilizer: 300 lb. of 0-12-12 broadcast.
150 lb. of 4-10- 6 in row.

The results are not very significant; too small differences were obtained between the different plots, especially in regard to the stand. Salt gave a decided increase in tonnage over comparable check at Paul Borton's farm. The results were less favorable for salt at Bartosek's. In none of the tests was salt harmful, even in this dry year. It was entirely unexpected that it should increase yields at all under such conditions.

The increased yields in the salt plots were not due directly to the control of black root. There was no reduction in stands in the

check, indicating that little or no black root was present. The increases were undoubtedly due to a fertilizer or physiological reaction of the sodium chloride. That a sugar beet needs sodium was demonstrated in 1912 by Dr. B. Schulze, of Breslau. His results are given in a publication entitled "Recent Investigations as to Nitrogen Fertilizers for Sugar Beets, by American Coal Products Company." He states that in 11 tests the yields from sulphate of ammonia are increased if sufficient common salt is used to correspond to the sodium content of an equivalent amount of nitrate of soda. He believes that increases in yields from sodium nitrate over sulphate of ammonia are due to the sodium present. This does not alter the situation in so far as control of black root is concerned. As was stated before, any element that would increase the growth of beets and make the plants more healthy would aid in checking black root. It would seem from this year's tests, that both nitrate of soda and salt should be used in the fertilizer treatments.

RECOMMENDATIONS FOR THE CONTROL OF BLACK ROOT

1. The following crop rotation: 5-year rotation, such as corn, sugar beets, oats or barley, alfalfa, and wheat; or corn, beets, oats, alfalfa, and alfalfa.
2. Standard fertilizer treatment as follows:
   200 to 300 pounds per acre of 0-12-12 broadcast
   100 to 150 pounds per acre of 4-10- 6 in row
   100 to 150 pounds per acre nitrogen carrier side-dressing
3. 500 pounds of salt broadcast per acre. Possibly 75 pounds per acre in the row will be sufficient.
4. Early planting, before May 10 if possible. A good seedbed with plenty of moisture insures good growth of the seedling.

Further work on the use of salt is contemplated. In the meantime it would seem that its use is warranted, especially on soil that has given a poor stand of beets.

EARLY SWEET CORN VARIETY TRIALS, 1929

ROY MAGRUDER

The better varieties from the 1928 trials, reported in the January-February, 1929, Bimonthly Bulletin, were again planted in 1929 for purposes of comparison with the many new varieties and strains added to the test.

Twenty hills of each variety or strain were planted in two adjacent rows in a plot of well-fertilized Wooster silt loam soil on May 23, 1929. The rows were 3 feet apart with hills spaced 2½ feet apart in the row. Five seeds were planted and the plants later thinned to three in each hill.

Harvests of the ears in late milk or early dough stage were made at 3- or 4-day intervals throughout the season. The number and weight of ears to the nearest 0.1 pound were recorded for each harvest. Husks were then stripped back, length and diameter measured, and number of rows of kernels counted on each ear.

The height of the base of the ear from the ground and the total height of the plant were measured after harvest began. If fewer than 75 per cent of the plants in each lot bore 2 ears the variety was listed in Table 1 as having 1-2 ears; if more than 75 per cent bore 2 ears, it was listed as 2 ears.

Germination was started by abundant rainfall and favorable temperature following planting, but the extremely cool nights of early June delayed both germination and growth and resulted in a poor stand of some lots of seed. Growth during June was rapid due to favorable temperatures and abundant rainfall. A very cool and dry August, however, delayed ripening, as indicated in Table 1 by the long period over which harvesting was continued. A shortage of moisture during the last half of August and the first week in September reduced the yield of the varieties which matured during this period.

In general, however, it required about 6 days less time to produce marketable ears in 1929 than in 1928.

Table 1 contains data on the important ear and plant characters, the varieties being arranged in order of earliness based upon the percentage of the total number of ears pulled at each harvest date for the 33 varieties and strains of white, and 26 varieties and strains of yellow, sweet corn included in the 1929 trials.

NOTES ON WHITE VARIETIES

Earliest-Vaughan was again the earliest white variety. Earliest from Beckert had slightly longer ears but otherwise was identical with Alpha from Harris and Rice.

Pickaninny is not, strictly speaking, a white variety as the kernels turn bluish-purple when ripe. If picked before the dough stage is reached the kernels are white and of very good quality.

Early Surprise-Woodruff and Forbes, Early Market-Rice and Gill, 60-Day Makegood, and Early Irondequoit varieties all belong

TABLE 1.—Earliness and Yield Data on 1929 Sweet Corn Variety Test

Days from planting to harvest		71	73	77	80	83	87	91	97	101	104	108	113	Ears							Plant height
Date of harvests		7/25	7/27	7/31	8/3	8/6	8/10	8/14	8/20	8/24	8/27	8/31	9/5	Av. wt.*	Length†	Diameter†	Rows of kernels		Per plant	Height from ground	
Variety	Seedsman	Per cent of total number of ears harvested on each date												Lb.	In.	In.	(Mode)‡ No.	(Range) No.	No.	In.	In.
White Varieties																					
Earliest	Vaughan	34	32	20	14	....	....	....	....	....	....	....	....	.332	5 -6½	1¼-1½	8	8-12	1-2	8-12	46-54
Pickaninny	Will	20	34	32	14	....	....	....	....	....	....	....	....	.236	5 -6	1¼-1½	8	8-12	1-2	6- 9	36-48
Early Surprise	Woodruff	....	37	41	22	....	....	....	....	....	....	....	....	.496	5 -7	1¾-2	12	8-14	1-2	8-12	48-54
Early Market	Rice	....	32	60	8	....	....	....	....	....	....	....	....	.524	5 -7	1¾-2	12	8-16	1-2	8-12	48-54
Midget	Stumpp & Walter	....	26	48	26	....	....	....	....	....	....	....	....	.407	3 -4	1 -1¼	8	8	1-2	4- 9	24-32
Early Surprise	Forbes	....	24	52	24	....	....	....	....	....	....	....	....	.470	5 -7	1¾-2	12	8-14	1-2	8-12	48-54
Earliest	Beckert	....	24	50	26	....	....	....	....	....	....	....	....	.415	5 -7½	1¼-1¾	8	8-10	1-2	9-16	54-60
Gill's Early Market	Gill	....	22	42	36	....	....	....	....	....	....	....	....	.593	6 -7	1¾-2	12	8-16	1-2	8-12	42-60
Alpha	Harris	....	19	56	25	....	....	....	....	....	....	....	....	.383	5 -7	1¼-1¾	8	8-12	1-2	10-16	54-60
Alpha	Rice	....	18	54	28	....	....	....	....	....	....	....	....	.327	5 -7	1¼-1¾	8	8-12	1-2	10-16	54-60
60-Day Makegood	Vaughan	....	....	55	45	....	....	....	....	....	....	....	....	.566	5 -7	1¾-2	12	8-16	1-2	8-12	42-60
Mammoth White Cory	Rice	....	....	26	48	26	....	....	....	....	....	....	....	.558	6 -7½	1½-1¾	12	8-14	1-2	10-14	48-56
Early Columbia	Woodruff	....	....	20	54	26	....	....	....	....	....	....	....	.660	6 -8	1½-2	12	8-16	1-2	12-20	48-66
Extra Early Cory	Moore	....	....	17	38	28	17	....	....	....	....	....	....	.520	6 -8	1½-1¾	12	8-12	1-2	12-16	48-60
Mammoth White Cory	Harris	....	....	12	88	....	....	....	....	....	....	....	....	.475	6 -7½	1½-1¾	12	8-12	1-2	10-14	48-56
Early Irondequoit	Hart & Vick	....	....	9	39	17	35	....	....	....	....	....	....	.491	5 -7	1½-1¾	12	8-16	1-2	8-12	48-60
Extra Early Dighton	Rice	....	....	3	23	11	14	49	....	....	....	....	....	.718	5½-8	1½-2¼	10	8-16	1-2	10-12	48-56
Allen's Choice	Allen	....	....	....	11	2	26	11	26	4	20	....	....	.524	6 -8	1½-1¾	8	8-12	2	16-18	66-76
Honey Dew	Stumpp & Walter	....	....	....	....	50	50	....	....	....	....	....	....	.190	5 -6	1 -1¼	8	8-10	1-2	8-12	36-42
Early Fordhook	Burpee	....	....	....	....	12	45	27	8	2	6	....	....	.532	6 -8	1½-1¾	8	8-12	1-2	14-22	66-84
Early Wonder	Simon	....	....	....	....	8	28	17	33	3	11	....	....	.600	5 -8	1½-1¾	12	8-16	1-2	14-24	62-76
Pocahontas	Harris	....	....	....	....	7	42	29	15	....	7	....	....	.679	6 -8½	1¼-1¾	8	8-12	1-2	14-30	64-84
Vanguard	Stokes	....	....	....	....	....	36	....	48	13	3	....	....	.661	6 -7	1½-2¼	12	8-16	2	20-30	72-84
First of All	Buckbee	....	....	....	....	....	27	19	46	8	....	....	....	.561	5 -7	1½-1¾	8	8-12	1-2	18-24	60-72
Whipple's Early White	Rice	....	....	....	....	....	26	44	16	4	10	....	....	.673	6 -8	1½-2¼	16	12-20	1-2	20-30	72-86
Premo	Holmes	....	....	....	....	....	17	29	23	....	31	....	....	.634	6 -8	1½-1¾	8	8-12	1-2	20-36	72-90
New Early Sunrise	Buckbee	....	....	....	....	....	....	64	15	4	17	....	....	.560	6 -7½	1½	12	8-16	2	20-26	76-84
Forbes' Early	Forbes	....	....	....	....	....	....	18	46	20	9	7	....	.732	6 -9	1½-2	12	8-16	2	22-40	76-96
Early Saskatchewan	Burgess	....	....	....	....	....	....	17	39	20	24	....	....	.483	6 -8	1½-1¾	12	8-16	2	18-26	66-76
Delicious	Burpee	....	....	....	....	....	....	....	14	11	25	17	33	.703	6 -8½	1½-2	12	8-16	1-2	22-30	72-84
Branching	Burpee	....	....	....	....	....	....	....	3	5	57	35	....	.370	4 -6	1¼-1¾	12	8-14	2	28-40	66-90
Delicious	Holmes	....	....	....	....	....	....	....	....	33	67	....	....	.373	4 -6	1¼-1½	12	8-14	2	20-40	72-84
Country Gentleman	Rice	....	....	....	....	....	....	....	....	10	28	62	....	.616	6 -8½	1½-1¾	zigzag	....	1-2	30-48	84-96

*Weight of ear and husk. †Dimensions of husked ear. ‡Largest number of ears with this number of rows.

TABLE 1.—Earliness and Yield Data on 1929 Sweet Corn Variety Test—Continued

Days from planting to harvest		71	73	77	80	83	87	91	97	101	104	108	113	Ears							Plant height
Date of harvests		7/25	7/27	7/31	8/3	8/6	8/10	8/14	8/20	8/24	8/27	8/31	9/5	Av. wt.*	Length†	Diameter†	Rows of kernels (Mode)‡	Rows of kernels (Range)	Per plant	Height from ground	
Variety	Seedsman	Per cent of total number of ears harvested on each date												Lb.	In.	In.	No.	No.	No.	In.	In.
								Yellow Varieties													
Golden Gem "C"	N. D. Exp. Sta.	64	18	...	18	...	...	...	...	...	...	...	...	.235	5 -6	1¼-1½	8	8-12	1-2	6-10	40-48
Golden Gem "A"	N. D. Exp. Sta.	17	45	21	17	...	...	...	...	...	...	...	...	.240	5 -6	1¼-1½	8	8-12	1-2	6-10	40-48
Banting	Will	...	3	39	28	6	18	6	...	...	...	...	...	.263	5 -6½	1¼-1½	8	8-12	1-2	4-10	36-46
Golden Early Market	Gill	...	...	42	58	...	...	...	...	...	...	...	...	.625	6 -7½	1¾-2¼	12	10-16	1	10-16	52-60
G. B. Doublecross "A"	Northrup-King	...	...	27	53	20	...	...	...	...	...	...	...	.303	5 -7	1¼-1½	8	6- 8	1-2	8-12	54-60
Extra Early Bantam	Harris	...	...	20	73	4	2	...	...	...	...	...	...	.429	5 -7½	1¼-1¾	8	8-12	1-2	12-22	60-72
The Burpee	Burpee	...	...	18	59	15	8	...	...	...	...	...	...	.441	5½-7½	1½-1¾	12	8-14	1-2	10-14	54-60
G. B. Doublecross "B"	Northrup-King	...	...	18	56	16	10	...	...	...	...	...	...	.346	5 -7½	1¼-1½	8	8-12	1-2	12-16	60-66
G. B. Singlecross "C"	Northrup-King	...	...	12	88	...	...	...	...	...	...	...	...	.272	5 -6	1¼-1½	8	8	1-2	10-14	48-50
G. B. Singlecross "D"	Northrup-King	...	...	12	53	27	8	...	...	...	...	...	...	.291	5 -6½	1¼-1½	8	8-10	1-2	10-12	54-60
Golden 60-Day	Vaughan	...	...	10	69	13	8	...	...	...	...	...	...	.553	5 -7½	1½-1¾	12	8-16	1	10-16	54-60
G. B. Recombination "E"	Northup-King	...	...	5	58	14	16	7	...	...	...	...	...	.330	5 -7	1¼-1½	8	6- 8	1-2	12-20	54-60
Golden Sunshine	Will	...	...	...	82	9	9	...	...	...	...	...	...	.482	6 -8	1½-1¾	12	8-12	1-2	12-14	60-66
Extra Early Yellow	Woodruff	...	...	...	70	17	13	...	...	...	...	...	...	.466	5 -7	1¼-1¾	8	8-12	1-2	12-22	60-72
Lord's Golden Age	Stokes	...	...	...	50	21	29	...	...	...	...	...	...	.386	5 -7	1¼-1½	8	8-12	1-2	12-20	48-72
Golden Sunshine	Rice	...	...	...	45	33	22	...	...	...	...	...	...	.574	6 -8	1½-1¾	12	8-16	1-2	12-14	60-66
Imp. Golden Bantam	Gill	...	...	...	24	13	50	13	...	...	...	...	...	.487	5 -7½	1½-1¾	12	8-16	1-2	12-16	56-64
G. B. Recombination "F"	Northrup-King	...	...	...	15	6	20	26	16	2	15	...	...	.395	5 -8	1¼-1½	8	8-10	1-2	14-22	60-76
Burbank	Stark	...	...	...	2	4	23	38	19	8	6	...	...	.534	5 -7½	1½-1¾	12	8-16	1-2	14-20	66-72
Golden Bantam	Burpee	...	...	...	...	6	23	65	6	...	...	...	...	.400	5½-8½	1¼-1½	8	8-10	1-2	12-24	54-72
Golden Dawn	Farquhar	...	...	...	...	6	24	18	28	6	18	...	...	.424	5 -7½	1¼-1¾	8	8-12	1-2	14-22	66-72
Golden Nuggett	Farquhar	...	...	...	...	2	20	29	42	7	...	...	...	.378	5 -7	1¼-1½	8	8-12	1-2	14-22	60-66
Seymour's Sweet Orange	Burpee	...	...	...	...	...	...	49	32	8	11	...	...	.454	6 -7½	1¼-1½	12	8-14	2	20-30	72-84
Whipple's Yellow	Rice	...	...	...	...	...	...	29	13	44	14	...	...	.672	6 -8	1½-2	12	10-18	1-2	28-36	84-96
Sunnybrook	Burpee	...	...	...	...	...	...	5	25	42	28	...	...	.668	6 -8½	1½-1¾	12	8-14	1-2	20-26	60-72
Early Golden	Aggeler & Musser	...	...	...	...	...	...	4	33	33	30	...	...	.669	6 -8	1½-2	12	10-16	1-2	28-36	84-96

to the same type and differ slightly in earliness and size. They are characterized by short, thick-stalked plants bearing 1 to 2 thick, chunky ears with about 12 rows of medium-width, white kernels and are rapidly replacing Alpha because of their earliness and large, well-filled ears.

Early Columbia-Woodruff was variable in plant and ear characters; the majority were like Early Surprise or Early Market but some plants were larger and later.

Midget was a very short plant with stalk and leaf midrib of dark purplish-brown color and tiny ears. Honey Dew was of the same type but larger, later, and not as heavily colored. They are of no commercial importance.

Fig. 1.—Representative plants of (A) Golden Gem, (B) Golden Early Market, and (C) Golden Sunshine sweet corn. The black lines on background are one foot apart

Extra Early Dighton-Rice had large sized ears, but the kernels had pink chaff which turns an undesirable brown upon cooking. It also had wide spaces between the pairs of rows of kernels. First-of-All also had pink chaff and wide spaces between rows of kernels.

Vanguard was more productive than Whipple's Early White because of a better stand and larger average number of ears per stalk. The seed is quite starchy and will resist more unfavorable weather during germination than sugary seed.

Delicious-Burpee is distinctly different from Delicious of Holmes. The ears of Holmes' Delicious are similar to those of Burpee's Branching but the plants are taller, have thicker stalks, shorter internodes, and wider leaves.

Branching from Burpee produced many slender suckers but few of them produced any ears under these conditions, and none of the main stalks produced more than 2 small, slender, tapering ears.

Summary.—The following varieties would seem to meet the requirements of the commercial grower, taking into consideration earliness, size, and market quality: Earliest-Vaughan, Early Surprise or Early Market, Vanguard or Whipple's Early White.

NOTES ON YELLOW VARIETIES

Golden Gem is a new variety originated at the North Dakota Agricultural Experiment Station and was the earliest yellow variety in this trial. The ears are of good size and quality for an extra early variety and are identical in character with the Banting variety as distributed by the originator.

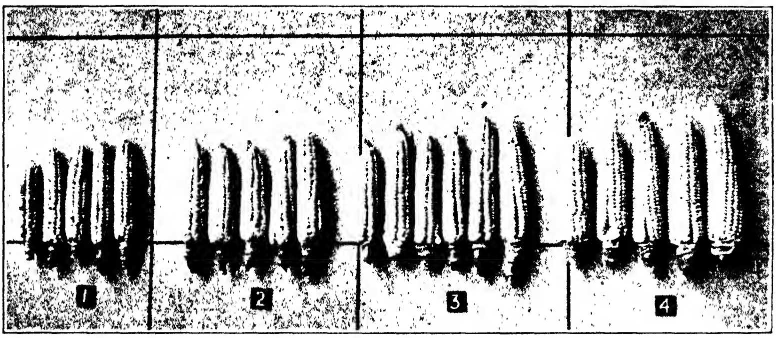

Fig. 2.—Representative ears showing the range in character of (1) Pickaninny, (2) Earliest-Vaughan, (3) Alpha, and (4) Early Market-Gill varieties of sweet corn. The black lines on background are one foot apart.

Banting-Will had approximately 5 per cent of plants that were larger and later than the original type of this variety.

Golden Early Market, The Burpee, Golden 60-Day, Imp. Golden Bantam, and Burbank all belong to the same type, differing slightly in earliness and size but all characterized by medium-sized, thick-stalked plants bearing thick, chunky, slightly tapering ears with 12 rows of medium-width, yellow grain. They are recommended as an early yellow where the market does not insist on the 8-rowed Bantam type.

Extra Early Bantam-Harris and Extra Early Yellow-Woodruff are of the same type but differ in earliness, both being earlier than Golden Bantam. They are variable in plant and ear characters. The majority of the plants are of the slender, many-suckered Bantam type but bear ears that are lower on the stalk, shorter,

thicker, earlier, and with more rows of grain than Golden Bantam. Some plants resemble Golden Early Market.

Will's strain of Sunshine was smaller and earlier than Rice's.

Lord's Golden Age was variable in plant and ear characters, the majority of the plants being of the slender Bantam type with shorter, earlier-maturing ears. Some of the plants were shorter, thicker, and earlier maturing than the Bantam type. Some of the dry seed were wine-red in color.

Golden Dawn and Golden Nuggett from Farquhar were of Golden Bantam type differing slightly from it in size and earliness. Both were more uniform in plant and ear characters.

Early Golden from Aggeler and Musser and Whipple's Yellow from Rice were identical.

The results of the Northrup King double and single crosses and mass recombinations of inbred lines are included in this report to show the progress already attained by following scientific principles in the improvement of sweet corn. Note the earliness of these strains compared with Burpee's strain of Golden Bantam. The single and double crosses were more uniform than any of the commercial varieties in the test and every plant produced a marketable ear. Uniformity of size and maturity is of practical importance to the commercial grower as it will enable him to grow and market his crop more economically by reducing the number of pickings necessary to harvest the crop and increasing the number of marketable ears per acre.

Summary.—The following varieties in the respective harvest classes and types are recommended for trial: Golden Gem, Golden Early Market, Extra Early Bantam, Golden Sunshine, and Whipple's Yellow.

PUBLIC RESPONSIBILITY IN FOREST LAND OWNERSHIP

EDMUND SECREST

The farm woods under private ownership comprise the major portion of the forests and forest lands of Ohio. Not only do they exceed in area the timber lands controlled by owners whose business is other than farming, but they have produced a large proportion of the hardwood timber used in the State. They will doubtless continue to be an important factor in forestry in the future.

The farm forest, however, is not an adequate solution of the State's forestry problem, granting even our ability to place these areas on a higher yield and continuous production basis and, in addition, to provide for the reforestation of idle land on occupied farms.

There is the increasing menace of idle lands through the abandonment of farms in the submarginal agricultural regions of the State; these must be returned to forest. The amount of such land is not known, but it is certain that the area is increasing rapidly under the present agricultural situation. There are, in addition, the constantly accumulating forest lands in large tracts; some of these were at one time owned as farms and were, in part, the holdings of timberland owners. On most of these lands the timber has been devastated and there is no interest among the owners in the regrowth of the forest.

Fig. 1.—Christmas trees on abandoned land

The maintenance of forests, to an appreciable extent, by private owners is desirable in every respect, but if private ownership fails to maintain the timber lands in a productive condition, if it fails to include the rapidly reverting agricultural lands in a program of reforestation, it is obvious that the public interests will require that these lands be placed under some form of ownership that will insure productive use. The Nations of Europe long ago solved their comparable forest and land problems by public ownership, either by the nation, state, or municipality. State ownership of larger areas is obviously the solution of the Ohio situation.

While we are large consumers of wood, the production of timber does not constitute our forest problem in its entirety. We are vitally concerned with protection forests, and they are

recognized as the peculiar function of the government. The protection of the watersheds of streams, the checking of soil erosion and soil losses, the silting of stream channels, the stability of water supply, and the consequences of stream pollution are largely dependent upon the forest cover and are factors in which the public has a vital interest.

We are concerned with a dense population, and this inevitably brings up the matter of forest recreation. Our people cannot longer have free access to forest and stream. Trespass laws are in effect; landowners are inclined to post their lands. Outdoor recreation, in consequence, has become a problem of paramount importance in our national and social life. The phenomenal invasion of our state parks and public scenic areas is evidence of this. It is well now to issue a word of warning lest our best scenic areas be absorbed by the estates of the rich or taken over by commercial interests to despoil and be made a source of private gain. The outstanding and unusual areas of scenic value are too limited to permit them to escape public ownership and regulation for the public good.

The most essential use of the public forest is to restore our denuded timberlands to a high degree of productiveness and to return to forest the constantly increasing areas of idle lands that are a menace to our industrial and social welfare. Public ownership is the only solution in sight for the restoration of many of these local political units in Ohio. They can be converted into forest communities in which the forest will supply the timber for wood-using industries, thus assuring the stable use of land that has become a liability under agricultural practices and assuring the stability of communities engaged in a permanent industry.

It was with this development in view that Ohio, through its Division of Forestry located at the Experiment Station, initiated a program of state forest acquisition in 1916.

In 1920, after the World War, greater impetus was given to the acquisition program and it has continued up to the present time. Six state-forest units have been established in the timberland regions of the State, and the total area acquired is approximately 55,000 acres. These units are a nucleus for expansion and will be able to supply the raw product for wood-using industries. The State forests are located in Ross, Pike, Scioto, Lawrence, Athens, and Vinton Counties. The average cost of the lands acquired was approximately $6.00 per acre. Many purchases were made at $4.50 and $5.00 per acre. Approximately 90 per cent of the state-forest areas are stocked with second-growth native forest. The old fields are planted to forest, largely pine.

In 1923, a Legislative enactment authorized the Forestry Division to acquire forest parks, with a view to bringing under public ownership examples of the State's outstanding scenery, virgin forest, and unusual flora, and to make them available for use by the public for recreation and study. Some 16 tracts of land of this character have been obtained either by purchase or gift, aggregating 5,500 acres. Two tracts, the John Bryan Park in Greene County and the Virginia Kendall Park in Summit County, were gifts to the State.

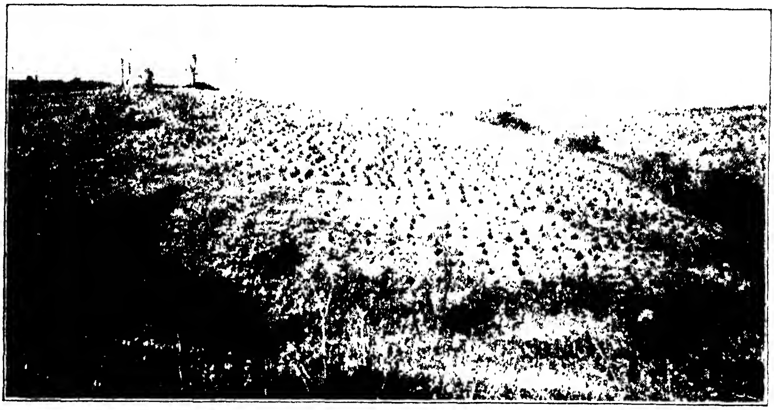

Fig. 2.—Idle land planted to pine forest. Taken 3 years after planting

While the State's program of forest land acquisition is progressing, it should be given greater impetus. Five hundred thousand acres of state forests could well be the goal in a ten-year program.

It is not contended that public ownership of forest lands will necessarily involve less expense in promoting forest production, but it is almost certain that our devastated forests and abandoned farms will be a liability until some public agency assumes responsibility for restoring their productivity.

Subsidies to private timber land owners in the form of tax reduction or exemption is an expense that the local tax districts or the commonwealth must bear. It not only involves expense to subsidize private forestry, but, in the end, it is uncertain of results, because it does not secure a guarantee for continuous production and against ultimate devastation. The goal is to keep in view the ideal of permanent public benefit. The history of forestry indicates that it can be attained where public ownership and control play an important rôle in the forest systems.

TENANT OPERATORS WHO ARE OWNERS-IN-PROSPECT

E. D. TETREAU

It is safe to predict that a considerable proportion of Ohio farmers who are now operating farms as tenants will eventually become farm owners. Some will acquire a farm by out-and-out purchase. Others will receive help, usually from relatives, in achieving ownership. There is a third group, now operating as tenants, the members of which expect to receive a farm by gift or inheritance. In this brief discussion, attention is directed toward the latter group.

In a group of 610 Madison and Union County (Ohio) farmers visited during the summer of 1928, there were 270 who would be listed in the census as tenants; of these tenants 48 were living on and operating farms which they expected to receive as their own by gift or inheritance.

The 305 farmers visited in Madison County included 140 owners and 165 tenant operators, or 54.1 per cent. Union County's 305 farmers included 165 owners and 105 tenant operators, or 44.3 per cent. Thirteen of the Madison County tenants were farming land which they expected to receive by inheritance or by gift; while thirty-five of the Union County tenants also expected to receive the land they were farming by gift or inheritance.

The term "owners-in-prospect" as here used refers to these tenants, already described, as living on and farming land which they expect to receive as theirs by gift or inheritance.

TABLE 1.—Tenants Who Are Owners-in-prospect

Counties	All farmers	Owners	Tenants	Tenants who are owners-in-prospect	
				Number	Per cent
Madison	305	140	165	13	7.9
Union	305	200	105	35	33.3
Total	610	340	270	48	17.8

It will be seen by Table 1 that 17.8 per cent of the tenant operators were owners-in-prospect. But Madison County, with 54.1 per cent tenant operators, shows 7.9 per cent of them to be owners-in-prospect; while Union County, with 34.4 per cent tenant operators, shows 33.3 per cent of them to be owners-in-prospect.

A further analysis of the data shows, when arranged in areas according to the per cent of tenant operators to total farms, that the proportion of tenants who were owners-in-prospect increased as the proportion of tenancy decreased, but at a much more rapid rate.

Groups	Total number of farmers	Per cent tenant operators	Per cent of tenants who were owners-in-prospect
High tenancy	264	60.8	7.3
Medium tenancy	203	41.9	18.9
Low tenancy	203	25.1	41.2

FARM BUSINESS SUMMARIES FOR 1927, 1928, AND 1929

J. I. FALCONER

Since 1910 the Department of Rural Economics has been making financial summaries of the year's business on Ohio farms. The Bimonthly Bulletins of November-December, 1926, and January-February, 1929, carried a summary of 5,486 such records for the period up to and including 1927. The present article includes the summaries for 1928 and 1929, in addition to those of 1927. There are 562 records included for 1928 and 714 for 1929. The data have been compiled from farm account books and show the principal sources of income as represented by cash sales from these farms; the main sources of income have been arranged in order of importance. The receipts given are total cash receipts from sales and do not include non-cash income, such as produce furnished by the farms to the farm household. The expenses are cash farm expenses and do not include as an expense the household or personal expenses, a charge for the farmer's own labor, or any interest on investment or indebtedness. Labor income has been figured by deducting from the receipts the farm expenses and 5 per cent interest on the investment. An increase in inventory value of the working capital has been figured as a receipt, and a decrease as an expense in computing labor income. The farms included are, perhaps, not altogether typical of the State or county, since they were selected to the extent that the farmers were keeping farm accounts; neither were all the same farms included each year as some dropped out and others came in. It is believed, however, that these records do give a fairly good indication of the sources of income in the various counties.

TABLE 1.—Farm Business Summaries

County		Year	No. of farms	Cash receipts per farm	Cash expenses per farm	Labor income
Auglaize and Mercer	Hogs, poultry, dairy, cattle	1928	22	3053	1573	794
	Hogs, poultry, dairy, cattle, wheat	1929	20	3411	1555	994
Brown and Clermont	Dairy, poultry, hogs, cattle	1928	12	2325	1435	528
	Dairy, poultry, hogs, cattle	1929	19	2340	1191	616
Butler	Hogs, dairy, poultry, wheat, cattle	1927	13	3772	1816	1003
	Hogs, dairy, poultry, cattle, wheat	1928	21	3627	2027	315
	Hogs, dairy, poultry, wheat, cattle	1929	21	4085	2143	943
Columbiana	Dairy, poultry, potatoes, apples, hogs	1928	15	3893	2230	1558
	Dairy, poultry, potatoes, hogs, apples	1929	22	4288	2461	1396
Crawford	Hogs, poultry, cattle, dairy, wheat	1927	18	3553	1612	617
	Hogs, cattle, dairy, poultry, sheep	1928	21	3304	2003	682
	Hogs, dairy, poultry, cattle, wheat	1929	15	4182	2554	1281
Darke	Hogs, dairy, poultry, wheat, cattle	1927	9	2853	931	1285
	Hogs, dairy, poultry, cattle, tobacco	1928	148	3150	1597	1091
	Hogs, poultry, dairy, wheat, cattle	1929	100	3241	1401	1007
Defiance and Fulton	Poultry, hogs, dairy, cattle, sheep	1928	19	4404	2307	1503
	Poultry, hogs, dairy, wheat, corn	1929	20	4670	2300	1872
Delaware	Dairy, hogs, poultry, sheep	1929	13	3607	1837	748
Erie	Dairy, corn, wheat, sheep, hogs	1929	9	3800	1320	1487
Franklin	Hogs, dairy, wheat, cattle, poultry	1927	47	4257	1692	1221
	Dairy, hogs, poultry, cattle, miscellaneous	1928	47	3524	1878	1059
	Dairy, hogs, poultry, wheat, cattle	1929	34	4761	2033	1916
Guernsey and adjoining counties	Dairy, poultry, cattle, sheep, miscellaneous	1928	30	2058	1118	613
	Poultry, dairy, miscellaneous, sheep, cattle	1929	26	2898	1548	779
Hancock	Hogs, dairy, poultry, cattle, sheep	1928	11	2476	1172	1095
Henry	Wheat, hogs, sheep, poultry, dairy	1927	9	4466	1660	833
	Hogs, poultry, cattle, dairy, corn	1928	18	4227	2459	1075
	Hogs, poultry, dairy, cattle, corn, wheat	1929	24	4322	2122	770
Huron	Dairy, wheat, hogs, sheep, cattle, poultry	1927	16	5506	2697	1090
	Dairy, hogs, sheep, wheat, poultry, cattle	1928	16	4848	2480	1084
	Dairy, hogs, wheat, sheep, poultry, cattle	1929	18	4342	2500	1158

The Bimonthly Bulletin

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Ohio Agricultural Experiment Station

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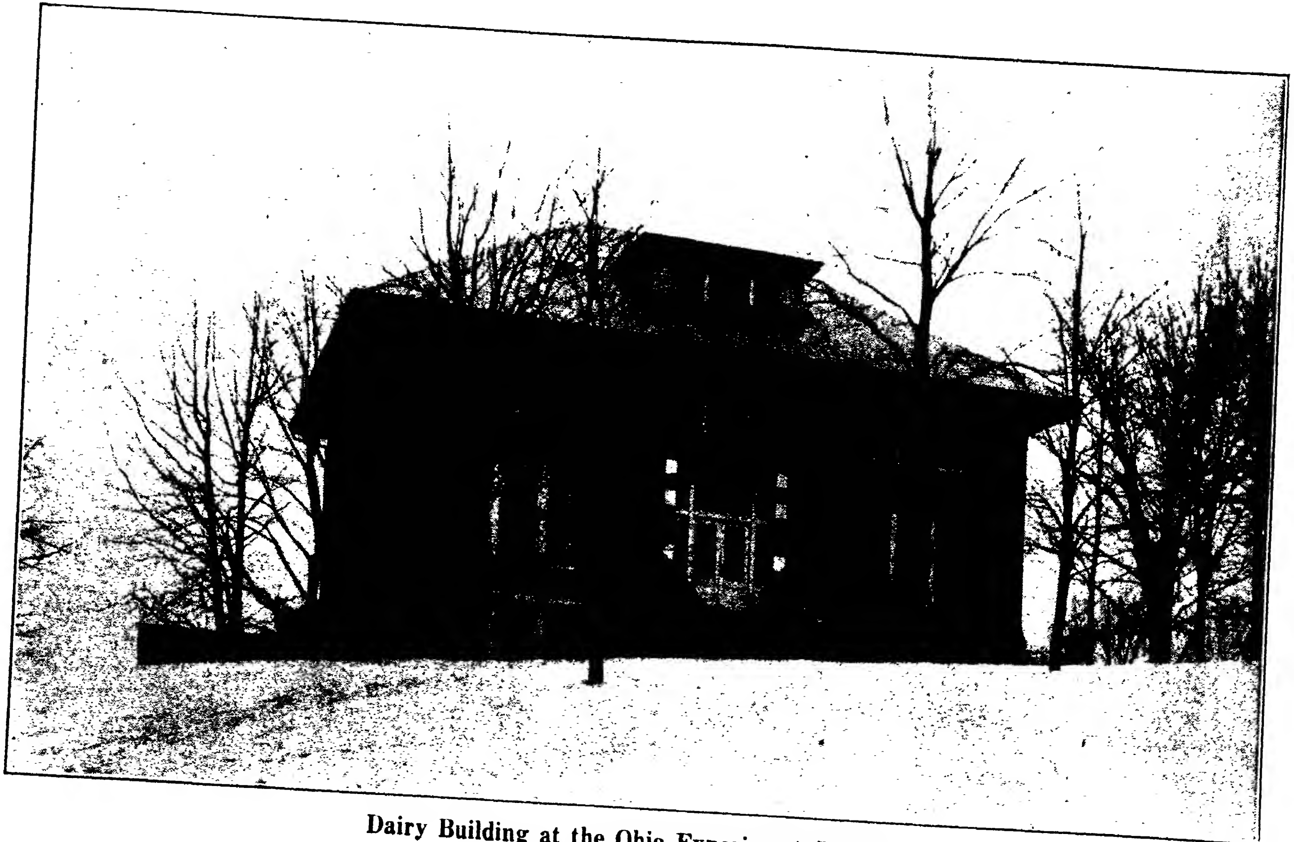
WOOSTER, OHIO, U. S. A.

Free Bulletin

C. G. Williams

Director



Dairy Building at the Ohio Experiment Station

THE ONION MAGGOT

J. P. SLEESMAN AND H. L. GUI

The onion maggot is the most destructive pest attacking the onion crop. In 1928 it caused a loss of approximately one million dollars in the Hardin County, Ohio, marshes.

HISTORICAL

The onion maggot has been known in Europe for many years. It was first referred to in the literature of American Entomology by Harris in his "Report on the Insects of Massachusetts Injurious to Vegetation," published in 1841. Since its food plant is of European origin it is probable that the insect was imported early in the nineteenth century, either as larvae or as puparia, in onion bulbs or refuse. Sailing vessels at that time used quantities of soil as ballast and it is possible that earth taken from European shores may have contained onion refuse carrying maggot puparia. It is significant to note that early reports of this insect were from seaport states such as Massachusetts and New York.

LIFE HISTORY AND BEHAVIOR

The insect overwinters within the puparium which is a reddish-brown structure, closely resembling a grain of wheat in size and shape. These puparia are generally found buried in the soil at a depth of 1 to 3 inches. Occasionally, they may be found in infested bulbs, especially about cull piles. In the late spring the puparia transform to adults and emerge over a period of 4 to 6 weeks. In a normal season emergence usually begins somewhat in advance of the time the young seedlings are pushing through the soil.

The adults are about the size of the housefly, grayish in color, rather bristly, and somewhat slender-bodied in appearance. The wings are comparatively large and are neatly folded above the abdomen when the insect is at rest. Ten to fourteen days after emergence the female fly begins to lay eggs for the first brood larvae. These eggs are deposited in the soil about the base of the plant, either singly or in groups of 2 to 14. The eggs are small, white, elongated structures, about 1/25 of an inch in length; they hatch in from 1 to 7 days, depending upon the temperature and humidity. The young larvae feed on the onion tissues and reach

maturity in about 15 days. They then crawl into the soil around the base of the plant and form puparia. After about 2 weeks the adults emerge from these puparia and lay eggs for another brood of larvae. In the last, or overwintering, brood the pupal stage lasts from 5 to 7 months.

Three distinct broods of flies were reared in the insectary in 1930. First brood adults were emerging on April 14, second brood adults on June 16, and third brood adults on August 2. Although the broods are distinct, overlapping generally occurs. Maximum egg deposition in the field for 1930 occurred about May 25. The first brood larvae were causing the maximum damage by the first week in June. Emergence of the spring, or first brood, flies was somewhat earlier than usual due to the warm spring.

The adult flies appear to be most active in the early morning and late afternoon hours. They are especially active in the calm period which usually follows a warm shower; however, when the wind is blowing to any extent the flies are inactive. They normally fly short distances and quite close to the ground, or perhaps just above the foliage. When at rest they may be found either on the ground or upon the foliage.

The rate of larval establishment is higher in soil with a high water content than in soil with a low water content. Therefore, heavier damage by the onion maggot is more likely to occur during wet seasons than during dry seasons.

INJURY

The onion maggot is not known to attack any plant other than the cultivated onion. Injury is largely confined to the first brood larvae. When the eggs of this brood hatch, the young maggot immediately crawls downward, usually following the stalk. Upon reaching the base of the plant it enters and begins to feed on the soft internal tissues. It burrows upwards within the stalk, generally not above the ground level. The work of this brood of larvae can be readily detected in the field, as the infested plant rapidly wilts, turns yellowish, and dies. See Figures 1 and 2. Upon being pulled the entire stalk is found to be consumed, leaving only the tough outer wall and the leaf sheathes. At this time the plants are quite small and the bulb has scarcely started to form. There is not enough food material present in any one young seedling to grow a maggot to maturity; therefore, the immature larvae must seek a new supply of food. A series of experiments conducted in 1930 indicates that 12 per cent of the migrating larvae find their

way to plants in neighboring rows, while 88 per cent move from one plant to the next one in the same row. This accounts for the characteristic spotting of the stand, as all of the plants in a row or in several adjacent rows may be cut down for a distance of several feet. Some growers make a practice of drilling the seed thickly with the idea of planting a few for the maggots. Unfortunately, the maggots do not do an even job of thinning.

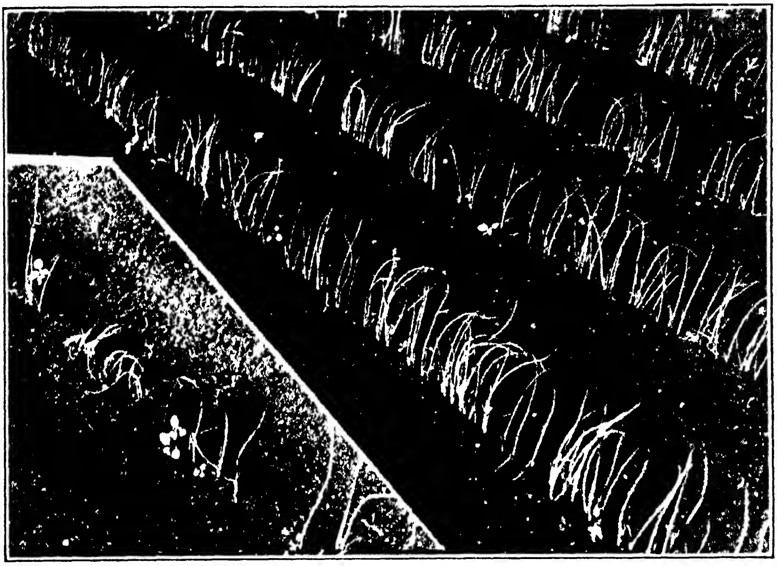


Fig. 1.—Normal stand of seedling onions with detail showing onion maggot injury in insert at left

By the time the second brood larvae make their appearance the bulb is beginning to form and, due to its rapid development, it is able to withstand the attack of a number of larvae. Even though the plant is not killed outright by the maggots, it never matures into a sound bulb and can be readily detected on the sorting screen. When the third brood larvae appear the bulb is nearing maturity or perhaps is mature; and if the bulb is attacked, rotting is a certainty. Injured or infested bulbs taken into the storage subsequently rot and they also cause surrounding bulbs to decay. Eggs for the second and third brood larvae are generally deposited directly on the plant about the bulb. There is a strong tendency for the female flies of these broods to deposit their eggs on infested plants or in local areas where an infestation is already present.

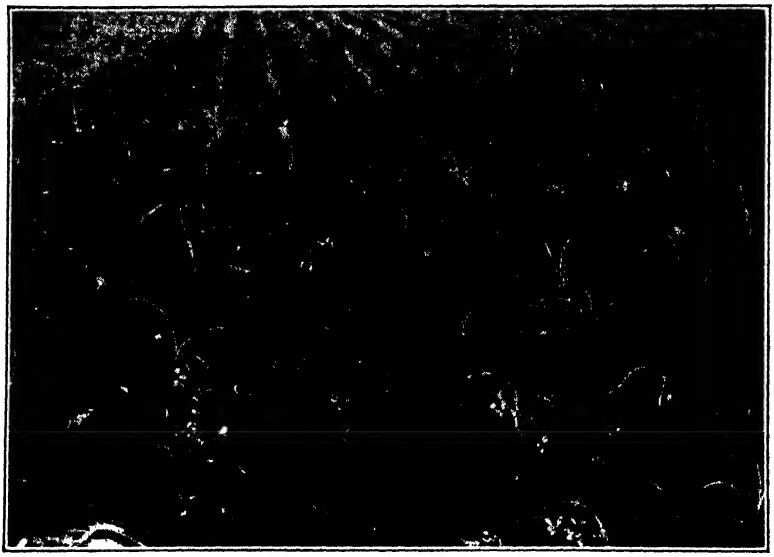


Fig. 2.—Section of an onion field showing extent of injury

NATURAL ENEMIES

The onion maggot is attacked by several parasitic and predacious species of insects. A small hymenopterous parasite of the Braconid family has been frequently reared from the puparia. A number of predacious ground beetles, either in the larval or adult stages, have been reported feeding on the onion maggot larvae. The field sparrow has also been noted to feed on the adults.

CONTROL

A 2 per cent lubricating oil emulsion in combination with a 4-6-50 bordeaux has proved effective against this insect. This spray is prepared by mixing 1½ gallons of oil emulsion with 48½ gallons of water, and then using this emulsion instead of water to make up the 4-6-50 bordeaux. Several commercial oil emulsions are available on the market. The material is applied under 20 pounds pressure and at the rate of 150 gallons per acre. Care must be taken that the spray be directed on the row so as to cover the ground for a distance of one inch on either side, in order that the majority of the eggs may be covered by the insecticide. The first application should be made about the time that the young plants are straightening out of the loop and repeated three or four times at weekly intervals. In securing good control it is very important that spraying operations be started early before any injury is

visible. The grower should not wait until the plants are going down to commence spraying. By that time many of the eggs have hatched and the feeding larvae are beyond the reach of the insecticide. As the female fly is usually actively laying her eggs by the time the young plants are an inch or so in height, it is well to start spraying as soon as possible after the onions may be readily observed in the row. It is also good practice to delay cultivation until after the spray has been applied as this operation tends to scatter some of the eggs beyond the reach of the insecticide.

Two types of power sprayers are in general use in onion maggot work. The Bolens Tractor outfit is very satisfactory under conditions where onions are grown on a small scale and in short rows. However, where onions are grown on a large scale, this type of sprayer is impractical on account of the small amount of spray which the tractor is able to carry. Large fields of a quarter to a half mile in length require a sprayer with sufficient carrying capacity to make possible a round trip with refilling at one end only. Such an outfit must have a large bearing surface in order to carry the machine over the soft loose muck. The machine which was developed in the Hardin County marshes in 1929 has proven very satisfactory. See Figure 3. An old model-T Ford chassis was used to carry the spray apparatus which was mounted directly back of the driver's seat. However, several alterations were required. Additional bearing surface was provided by removing the rims from the wheels and replacing them with ¼-inch by 6-inch strap iron tires. Also, an extra wheel was placed on the outside of each rear wheel giving dual traction. It is also quite essential that the machine move slowly. In order to provide this feature the drive shaft was cut off just back of the transmission and a Chevrolet transmission inserted. This provided for a very slow speed which could be easily maintained. A sprocket wheel, from which power was derived to run the spray pump, was placed between the two transmissions. A sliding spray boom was attached to the rear of the chassis and one man walked along behind to guide the spray on the row. In order that good coverage be secured the same rows that were drilled at any one time should be sprayed at the same time. The number of nozzles on the spray boom would then necessarily be the same as the number of gangs on the particular drill which was used in seeding. The usual method of refilling consists in driving the sprayer to a gravity tank located at one end of the field. Water for filling the gravity tank is usually taken from a drainage ditch.

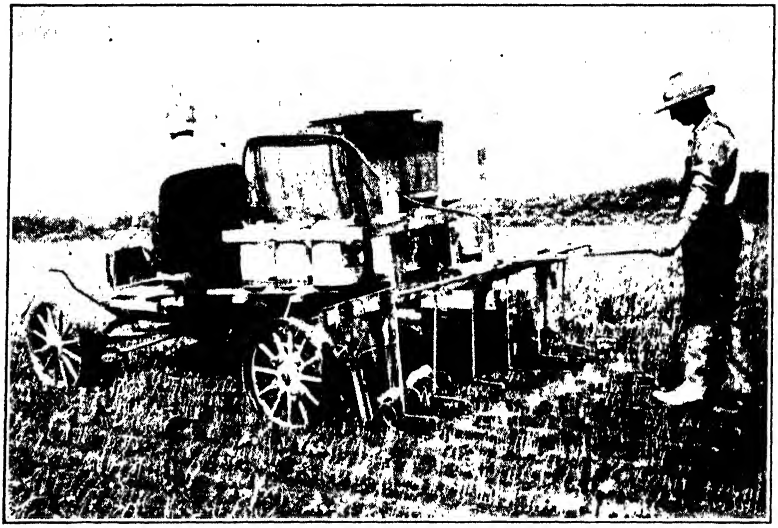


Fig. 3.—Sprayer in operation on the Dean Wolgamot Farm, McGuffey, Ohio

A sprayer of this type costs around \$300. This allows \$25 for chassis, \$75 for overhauling chassis, and \$200 for spray tank, pump, nozzles, and fittings.

Under certain conditions injury to the foliage of the onion plant results from the use of the bordeaux-oil emulsion. Experiments conducted in 1930 indicate that injury may be expected when application of the spray is made during periods of very high humidity. Such injury probably has little effect on the plant unless the very humid conditions prevail for several days after spraying. The most serious injury occurs when spraying is done during periods of low temperature and high humidity, especially when such unfavorable conditions continue for 3 or 4 days after spraying. Under such unfavorable conditions the plant grows slowly and thus the injury appears more pronounced. The best policy is to delay spraying when the temperature is likely to fall to near the freezing point and when the humidity is fairly high. Under favorable growing conditions the plant usually outgrows all visible injury within a week or ten days and any decrease in yield is more than compensated by increase in yield due to the control of the maggots, particularly if the outbreak for the season is serious.

It is of interest to note that observations indicate the use of a 2 per cent oil emulsion contributes to a significant degree in weed control. However, no detailed data on this point are available.

Clean cultural practices also tend to decrease the number of flies present in the field the following spring. Culls and other onion refuse should not be left lying about the field after harvest. Third brood adults deposit numerous eggs on such material and the maggots which hatch from these eggs mature and form over-wintering puparia. Cull piles should be burned either in the fall or early spring before the adults have an opportunity to emerge. The plowing under of infested onion bulbs is of questionable value as a control measure.

Poison-bait traps have been tried by a number of workers and have proven to be of little value in the control of this insect.

RECOMMENDATIONS FOR CONTROL

Spray with a 2 per cent lubricating oil emulsion in 4-6-50 bordeaux at the rate of 150 gallons per acre under 20 pounds pressure. The following formula is recommended:

Lubricating oil emulsion	1½	gallons
Copper sulfate	4	pounds
Hydrated lime, 300 mesh	6	pounds
Water	48½	gallons

Begin spraying as soon as the onions can be readily observed in the row. Repeat 3 to 4 times at weekly intervals. Direct the spray about the base of the plant.

Practice clean farming. Destroy by burning all culls and other onion refuse.

THREE PROMISING NEW VARIETIES OF SMALL FRUITS

J. S. SHOEMAKER

HOWARD SUPREME (Howard 25) STRAWBERRY

History and breeding.—The Howard Supreme (Howard 25) strawberry variety originated in 1909, at Belchertown, Mass., with Everett C. Howard, of A. B. Howard & Son. Mr. A. B. Howard was the originator of Howard 17 which is identical with the Premier of the nursery trade, and which is now probably the leading strawberry variety in Ohio. The Howard 25 was produced in the greenhouse in 1907 by controlled hand pollination, using Howard's No. 103 as the mother parent and Howard 17 as the pollen parent.

The following spring the seeds were sown in the greenhouse and the new seedlings fruited for the first time in the trial beds in 1909. This new variety was the most striking and distinct of any of the lot of 1,000 seedlings fruiting at the time from 10 different crosses made by A. B. Howard & Son. The mother plant, Howard's No. 103, was a seedling of the Crescent crossed by the Marshall. The Howard 17 was also a seedling of the Crescent crossed by another of the Howard seedlings, the No. 1. The No. 1 was produced by crossing still another one of the Howard seedlings, the No. 14, with pollen from the Clyde. The Clyde is a seedling of the Cyclone which in turn is a seedling of the Crescent. The No. 14 was a seedling of the Haverland crossed by the Belmont. The Haverland is a seedling of the Crescent. Between 1875 and 1890 the Crescent dominated all markets. The Crescent was used no less than four times in the lineage of the Howard Supreme (Howard 25).

A letter dated May 21, 1930, from A. B. Howard & Son to the Ohio Experiment Station concerning the Howard 25 reads in part as follows: "Although a pistillate, it is the best of more than 26,000 seedlings originating on our place, during a period of over 33 years."

Because of the restrictions under which the Howard 25 was received plants have not been distributed from the Ohio Experiment Station, except a few with Mr. Howard's consent. During the years under test at Wooster the behavior of Howard 25 has been outstanding in comparison with other varieties.

In the fall of 1929 and the spring of 1930, Mr. Howard released the Howard 25 to E. W. Townsend & Sons, Salisbury, Maryland, and it appeared for the spring trade of 1931 under the name Howard Supreme.

Description.—The plants are medium sized, vigorous, and have rather erect foliage. More plants are probably produced from each parent plant of Howard Supreme than from Premier.

The flowers of Howard Supreme are imperfect (pistillate); consequently, another variety must be planted with it as a pollinizer. Any perfect variety will probably suffice for the purpose.

Fruit is of good size, conic-wedge shape, somewhat irregular, dark crimson color, very attractive, and the seeds are very slightly sunken and for the most part yellowish; flesh is firm, meaty, sweet to subacid, and of very good flavor. The berry on the whole is darker and slightly firmer than Premier.

Howard Supreme ripens in early midseason. The peak of its picking season is later than that of Howard 17 (Premier). Its season of ripening and its good characters make it a desirable companion variety for Howard 17 (Premier).

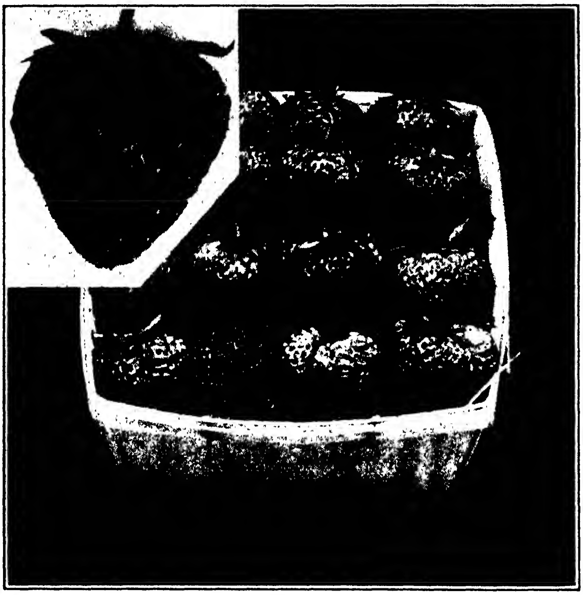


Fig. 1.—A quart box of Howard Supreme (Inset). A Howard Supreme Strawberry

A home canning test indicated that the juice and berry remain the same color for a reasonable time after canning, which is not the case with most varieties. Its firmness in canning was not ascertained. In the home canning test, the variety compared favorably with Senator Dunlap which is commonly used for canning purposes.

NEW LOGAN BLACK RASPBERRY

The New Logan is an outstanding new black raspberry variety. Probably its two most noteworthy characteristics are that it ripens about a week earlier and is more resistant to the virus diseases than the widely grown Cumberland.

History.—The New Logan is now probably the most popular variety in the Clyde district of Ohio. It was first brought to the district some 15 years ago. It is claimed that a Mr. Albaugh secured the first plants from a nurseryman in Illinois but efforts to trace its history further have not been successful. In most

respects the characters of New Logan seem to resemble those of the Plum Farmer type more than those of the Cumberland type.

Description.—In habit of growth, the New Logan bush is naturally lower growing and more spreading than the Cumberland. During the first year, especially, the New Logan does not make so much growth in height as the Cumberland but as time progresses it makes more canes to the hill.

The leaves of New Logan, like those of Plum Farmer, are usually darker green than those of Cumberland.

New Logan seldom is infected with leaf curl and is remarkably free from mosaic and streak diseases but not immune to them. The variety is susceptible to crown gall and to anthracnose.

In estimated life of plantation, the New Logan compares favorably with the Cumberland, providing disease and insect troubles are avoided and the plantation is given good cultural care.

The New Logan is a productive variety. The berries ripen about a week before those of Cumberland. Plum Farmer also is earlier than Cumberland, but the picking season of New Logan is longer than that of Plum Farmer. The New Logan seems to ripen more berries at one time in the cluster and consequently its picking season is slightly shorter than that of Cumberland.

Fig. 2.—New Logan black raspberry in a peach orchard at Clyde, Ohio, just before tip-layering time

The berries of New Logan, although of good size, are slightly smaller, on the whole, than those of Cumberland; the color is slightly darker than that of Cumberland; and the flavor of New Logan does not seem to be as sweet as that of Cumberland, but tastes vary with the individual. The core cavity is slightly narrower than that of Cumberland. The berries are reasonably firm; for example, truck-loads of the berry from Clyde arrive at Detroit in good condition.

The Ohio Experiment Station has demonstrated that the Cumberland variety can be maintained with an extremely low percentage of virus diseases and, under such conditions, the Cumberland is considered to be the superior variety. New Logan, however, is undoubtedly more resistant than Cumberland to virus diseases and may thrive where the latter will not. If an early berry is desired, New Logan has the advantage over the Cumberland. Planting both of them may be a good plan to lengthen the picking season.

The New Logan is well worth trial throughout the State.

CHIEF RED RASPBERRY

The red raspberry, Minnesota No. 223, now the Chief, has been under test for three years at the Ohio Experiment Station, and is now described because of the interest shown in the variety.

The Chief red raspberry, like the Latham, originated at the University of Minnesota Fruit Breeding Farm.

The plants of the Chief have been remarkably thrifty in growth, although they are not so tall as some other reds. The Chief compares very favorably with Latham in resistance to disease. Where mildew is serious the Chief may prove to be a better variety than the Latham.

Like many other red varieties the Chief should not be set near black raspberries, or the latter may soon become infected with virus diseases.

The plants bore quite a few berries the year they were planted. That it is a productive variety was indicated as the plants became more mature. During 1930 a short row of the Chief outyielded rows of similar lengths of Latham, Cuthbert, King, Newman, Herbert, St. Regis, and several other red varieties under test. Several other red varieties were not of the same age in the plantation as the Chief so their productiveness cannot be compared.

Chief begins to ripen before Latham, and over a reasonably long season. The berries are not so large as those of well grown

Latham or Cuthbert, but they are more uniformly colored than those of Cuthbert. The berries of the Chief are sweeter than those of Latham and seem to be less subject to crumbling.

The small to medium size of Chief berries is one of the principal drawbacks of the variety. Otherwise the Chief seems to be a promising early variety to replace the King, and is worthy of trial in comparison with other red raspberry varieties.

WHITEWASHING FRUIT TREES TO RETARD BUD DEVELOPMENT

C. W. ELLENWOOD

For the past several years the Department of Horticulture has been conducting some tests on the influence of whitewash in preventing spring frost injury to apple buds and blossoms. This is in no sense a new idea. In 1897 Whitten[1] reported on work of this nature on peach trees. The formula used in the work at Wooster was different from that reported by Whitten, and, no doubt, the use of a modern sprayer made it possible to cover the trees more efficiently and more rapidly.

In 1926 a number of trees were whitewashed in the Station orchards by means of a power sprayer. The work that year consisted mainly in testing various formulae for sprays that could be applied with a sprayer and that seemed to give promise of being practical. The best of these formulae were: (1) 40 pounds of hydrated lime and 2 pounds of Kayso (calcium caseinate) to 100 gallons of water, and (2) 40 pounds of hydrated lime, 30 pounds of salt, and 2 pounds of Kayso to 100 gallons of water.

Formula 2 was slightly superior in adhesive quality to No. 1, but the advantages did not seem sufficient to warrant the additional time required in its preparation.

During the years subsequent to 1926, the following formula was used, with slight variations: 50 pounds of hydrated lime and 2 pounds of Kayso to 100 gallons of water. This formula was applied with a power sprayer operating at about 350 pounds pressure. No difficulty was experienced from the spray guns clogging or from excessive sediment in the spray tank.

[1]Whitten, J. C. Winter Protection of the Peach. Mo. Exp. Sta. Bull. 38, 1897.

The first application of whitewash was made in March, while the trees were, to all appearances, dormant. A second application was made immediately after the regular dormant spray. In two years of the 4-year period (1927-1930) a third application was made. The trunks of the trees remained quite white until June 1.

Plum, cherry, and peach trees were whitewashed in a limited way, but this report is confined to the results obtained with two varieties of apples, Grimes and Jonathan. The Grimes and Jonathan trees used were set in 1900, being 27 years old the first year of the tests. The same row of Grimes trees was whitewashed each of the 4 years (Table 1), and the row of Jonathans used in the trial was whitewashed 3 of the 4 years (Table 2). It required an average of 18 gallons of solution per application to cover the trees. The cost of whitewashing, including material and cost of application, was 31.5 cents per application per tree. The number of applications required per year depends upon the amount of rainfall and the rate of bud development.

Fig. 1.—Grimes—Row on left whitewashed, in full bloom. Check row on right, most of petals have fallen

The purpose of whitewashing is to prevent absorption of heat, thus retarding bud development. Retarding the bloom 2 or 3 days may sometimes be sufficient to prevent serious frost injury. First bloom, as shown in Tables 1 and 2, indicates the day on which the first open blossom was noted, and full bloom, when the maximum number of blossoms were open. The end of full bloom represents the last day of the full-bloom period and is the time when active petal fall begins.

The greatest difference in bud development was noted in 1928 on Grimes. That year the temperatures for several weeks prior to full bloom had been rather uniform with relatively few consecutive days of high temperatures. It is during such seasons that whitewash might be expected to be most effective in retarding bud development.

In seasons when the temperatures are excessively high just before and during the bloom period there is apparently little, if any, advantage in whitewashing.

Fig. 2.—Grimes and Jonathan trees after first application of whitewash

There were generally more late opening buds on the whitewashed trees, as is indicated by comparing the dates of the end of full bloom (Tables 1 and 2). However, in the orchard in which this work was done this difference was not a factor in preventing frost injury, since in no year did freezing temperatures occur in the time representing the difference in the end of full bloom of the two plots.

INFLUENCE ON YIELD

It will be noted that the average annual yield per tree of both Grimes and Jonathan is greater on the whitewashed than the check plot. This difference in yield is probably not enough to be significant. The orchard in which these plots are located has been rather consistently free from frost injury. In locations which are

TABLE 1.—Results of Whitewashing—Grimes

Year	Plot	Average date first bloom	Average date full bloom	End of full bloom	Average yield per tree	Temperature for 45 days prior to and including date of full bloom			Temperatures during period of first to full bloom				
						Mean	No. days 30° or below	No. days 70° or above	Max.	Min.	Mean	No. days 30° or below	No. days 70° or above
					Bu.								
1927	Wh.	5/ 3	5/ 7	5/ 9	7.4	48.5	13	19	74	40	58.2	0	3
	x	5/ 1	5/ 7	5/ 8	2.4	48.5	13	19	74	30	56.3	1	4
1928	Wh.	5/ 8	5/15	5/19	30.4	48.9	12	13	88	29	54.3	2	4
	x	5/ 7	5/12	5/17	14.7	47.8	14	12	88	29	54.5	1	3
1929	Wh.	4/23	4/29	5/ 1	10.0	50.1	9	12	72	29	54.5	1	2
	x	4/22	4/27	4/30	7.0	50.1	9	12	72	29	51.8	1	2
1930	Wh.	4/28	5/ 1	5/ 3	16.5	46.8	22	11	83	45	63.5	0	3
	x	4/27	5/ 1	5/ 3	22.7	46.8	22	11	83	31	60.5	0	3
4-year average	Wh.	5/ 1	5/ 6	5/ 8	13.6	48.6	14	14	79	36	57.6	1	3
	x	4/29	5/ 4	5/ 7	11.7	48.3	15	14	79	30	55.8	1	3

Wh.—Whitewashed plot.
x—Check plot.

TABLE 2.—Results of Whitewashing—Jonathan

Year	Plot	Average date first bloom	Average date full bloom	End of full bloom	Average yield per tree	Temperature for 45 days prior to and including date of full bloom			Temperatures during period of first to full bloom				
						Mean	No. days 30° or below	No. days 70° or above	Max.	Min.	Mean	No. days 30° or below	No. days 70° or above
					Bu.								
1927	Wh.	5/ 1	5/ 9	5/10	14.6	49.7	11	21	85	30	58.0	5	1
	x	4/29	5/ 7	5/10	13.5	48.5	13	19	74	30	54.9	4	1
1929	Wh.	4/23	4/29	5/ 1	14.5	50.1	9	12	72	29	52.4	2	1
	x	4/21	4/28	4/30	13.8	50.0	9	12	72	29	52.0	2	1
1930	Wh.	4/27	5/ 1	5/ 3	9.2	46.8	22	11	83	31	60.5	3	0
	x	4/26	4/30	5/ 2	7.5	46.7	22	11	81	27	55.5	2	1
3-year average	Wh.	4/27	5/ 3	5/ 5	12.8	48.9	14	15	80	30	57.0	3	1
	x	4/25	5/ 2	5/ 4	11.6	48.4	15	14	76	29	54.1	3	1

Wh.—Whitewashed plot.
x—Check plot.

especially susceptible to frost injury it is possible that the differences in date of full bloom between whitewashed and check plots secured in these results would be at least sufficient to prevent total crop loss.

SUMMARY

The greatest difference in date of full bloom any year was 3 days. This is hardly equal to the difference in date of full bloom existing between some of the standard varieties of apples.

These data do not suggest the substitution of whitewashing for orchard heating since whatever value whitewash has in preventing frost injury ceases with full bloom and serious damage frequently occurs later than this period.

Trees must be whitewashed several weeks in advance of bloom regardless of subsequent temperatures.

The differences in yields as shown in these data, and certain other factors, suggest the possible value of continuing experimental work of this nature. However, these data do not indicate that it would be practical to include whitewashing as a regular orchard practice.

NEW AND DEPENDABLE VARIETIES OF VEGETABLES

ROY MAGRUDER

The tendency of the modern seedsman is to list fewer varieties of vegetables; however, most catalogs still list so many varieties that the amateur gardener is bewildered by the number of "best" varieties. The following table is offered as a guide to the better varieties; those varieties of special value for the home garden, because of high quality, etc., are indicated by an asterisk. They may or may not be of value to the commercial grower.

Practically all of the varieties here listed have been grown in the Station gardens and are believed to be the best in their respective classes, as outlined in the brief characterization following the variety name. A great many valuable varieties have been omitted, but this list contains a sufficient number of varieties to take care of the needs of most home gardeners and it also recommends some relatively new varieties that should be more widely used by commercial vegetable growers.

Name	Variety	Brief description
Asparagus	Mary Washington	Productive; purple tips; rust resistant.
Beans		
Yellow pod snap	Webber Wax or Crackerjack	Earliest, flat pod.
	Valentine Wax	Earliest, round pod.
	Wardwell Kidney Wax or Sure Crop	Quality, flat pod.
	Pencil Pod Black Wax	Quality, round pod.
Green pod snap	Bountiful	Earliest, good quality, flat pod.
	Full Measure	Earliest, good quality, round pod.
	Giant Stringless Green Pod	Quality, round pod.
Pole green pod	Kentucky Wonder	Early, stringy, round pod.
	*Ideal Market	Early, stringless, round pod.
Pole yellow pod	Kentucky Wonder Wax	Early, round pod,
	Golden Cluster Wax	Early, flat pod.
Pole lima	*Early Leviathan	Early, large, white, flat seed.
	Challenger or Dreer's Pole	Large, thick, green seed.
	Ideal	Large pods; large, flat, white seeds.
Bush lima	*Fordhook	Large, thick, green seed (potato lima).
	Burpee's Improved Bush	Large, flat, white seed.
Green-shell bush	French or Dwarf Horticultural	Large, oval, red-speckled seed.
Green-shell pole	Horticultural Pole	Large, oval, red-speckled seed.
Dry-shell or field	Michigan Robust Pea	Disease-resistant, "navy" bean.
	White Marrow	(Perry strain) large, white, for baking.
	White Kidney	Large, white, kidney-shaped.
	Well's Red Kidney	Disease-resistant, red, kidney-shaped.
Beet	Crosby Egyptian, Early Wonder	Early, for bunching.
	Detroit Dark Red	Late, round, dark red flesh (canning).
	*Long Season, Green Top, Winter Keeper or Century	Large, half-long; excellent quality; good keeper; green top.
Broccoli	Italian Green Sprouting	Cut sprouts before flowers open.
Brussels sprouts	Long Island Improved	Dwarf plant; dependable.
Cabbage	Jersey Wakefield	Earliest, pointed head; excellent quality.
	Golden Acre	Earliest, round head; productive.
	Glory	Midseason, round head (kraut).
	Succession	Midseason, flattened head,
	Danish Ballhead	Late, round head; good keeper.
	Iacope	Yellows-resistant, Copenhagen market (second-early, round).
	Marion Market	Yellows-resistant, Copenhagen market.
	Wisconsin All Season	Yellows-resistant, Succession.
	Wisconsin Hollander No. 9	Yellows-resistant, Ball head.
	Mammoth Rock Red	Late, round, purple (red).
	Drumhead Savoy	Crinkled or savoy; excellent quality.
Carrot	Chantenay	Thick, blunt roots; productive.
	Danvers	Half-long, blunt rooted; later.
	*Nantes or Coreless	Highest quality; cylindrical.
	Pride of Denmark or Feonia	Longer, later, Coreless type; good buncher.
Cauliflower	Early Snowball	Earliest, round, white head.
Celery	*Golden Plume or Wonderful	Early; branches easily (yellow).
	Easy Blanching	Midseason; blanches white.
	Giant Pascal	Late; blanches white; excellent quality; winter keeper.
Corn		
Sweet	Earliest (Vaughan Seed Co.)	Earliest white. 8 rows; small.
	Golden Gem	Earliest yellow; 8 rows; small.
	Early Market or Early Surprise	Earliest, 12-row white; medium size.
	Gill's Golden Early Market	Earliest, 12-row yellow; medium size.
	Whipple's Early White and Vanguard	Earliest, large-eared white.
	Whipple's Yellow	Earliest, large-eared yellow.

*Especially recommended for home gardens.

Name	Variety	Brief description
Corn Sweet (cont.).....	Golden Bantam	Midseason, excellent quality yellow; 8 rows.
	Country Gentleman	Late, excellent quality, white; zigzag rows.
	Late Mammoth, Columbus Market, and Long Island Beauty	Late, largest white.
Pop..............	*Japanese Hulless...............	Short, thick ears; slender white grain.
Cucumber	Early White Spine (Kirby Staygreen)	Earliest slicer.
	*Early Fortune.........................	Longer, darker, and later than Early White Spine.
	Boston Pickling or Green Prolific......	For pickles.
Eggplant	Black Beauty	Early; medium size; dark purple; productive.
	N. Y. Improved	Later, larger, and not as productive as Black Beauty.
Endive	Green Curled...........................	Large, finely divided leaves.
	Broad Batavian........................	Large, flat leaves with broad, white midribs.
Kale	Dwarf Scotch Curled.	Low plant; long, finely curled, light green leaves.
Kohl Rabi	White Vienna.........................	Early; small leaves; white skin.
Leek	Large American Flag..................	Large, long, straight.
Lettuce	*Black Seeded Simpson................	Early, loose leaf; excellent quality.
	Grand Rapids	Frilled, loose leaf; good shipper.
	*Mignonette	Earliest, crisp-head type; excellent quality.
	May King	Earliest, butter-head type; excellent quality.
	New York or Wonderful	Late, crisp "Iceberg" type.
	Big Boston......................	Late, butter-head type.
	Trianon	Cos type, self-folding.
Muskmelons	*Golden Champlain	Earliest; salmon-fleshed; medium size.
	Jenny Lind............................	Earliest; green-fleshed; small; excellent quality.
	Hearts of Gold.........................	Midseason; salmon-fleshed; good shipper; medium size.
	Bender Surprise	Midseason-late; large; salmon-fleshed; good shipper.
	Tip Top...............................	Midseason-late; salmon-fleshed; yellow skin; good quality.
Mustard	Fordhook Fancy........................	Large, light green, frilled, and cut leaf; long-standing.
Okra	White Velvet..........................	Long, slender, smooth, light green pods.
Onions	*Ebenezer or Japanese.................	(Sets for green or dry onions); flattened yellow; good keeper.
	Ohio Yellow	Flattened-globe shaped; good keeper and market onion.
	*Sweet Spanish.......................	Round; large; mild; good keeper.
	*Potato............	(Multiplier); for green and dry onions.
	*Egyptian (Topset)	Winter over for early green or bunch onions.
Parsley	Moss Curled	Dark green, finely cut, and curled leaves.
Parsnip	*Early Short French or Early Round...	Early, round roots; easily harvested.
	Hollow Crown or Guernsey.............	Long, smooth, white.
Peas	Laxton's Progress.....................	Earliest of large-podded, dwarf-plant type.
	Little Marvel..........................	Early, small pods; dwarf plant; productive; excellent quality.
	Improved Stratagem	Midseason, large pods; dwarf plants.
	Alderman or Duke of Albany...........	Late, tall, Telephone type.

*Especially recommended for home gardens.

Name	Variety	Brief description
Pepper		
Mild or sweet flesh	Harris' Earliest	Earliest red; small; thin-fleshed.
	Prolific Yellow	Earliest yellow; small; thin-fleshed.
	*Early Giant	Earliest, large-fruited red.
	*Oshkosh	Large, heart-shaped yellow; fine for stuffing or salad.
	*Sunnybrook or Tomato	Earliest, thick-fleshed "Pimento," tomato-shaped.
	California Wonder or Wonder Bell	Midseason-late; large, very thick flesh; red.
Hot or pungent flesh	Hungarian Wax	Medium size; yellow; semi-hot.
	Hamilton Market	Medium size; red; semi-hot.
	Red Cluster or Small Cayenne	Small; pointed; fiery hot.
	Long Red Cayenne	Long; pointed; fiery hot.
Potatoes	Irish Cobbler	Early; round; white-skinned.
	Russet Rural	Late; round; russet skin; productive.
Pumpkin	Small Sugar or New England Pie	Small; orange skin; dry, light-yellow flesh
	*Winter Luxury	Medium size; yellow netted skin; good keeper.
Radish	Early Scarlet Globe	Early; round; red.
	Early Scarlet White-Tipped	Early; round; red with white tip.
	White Icicle	Early; half-long; white; excellent quality.
	White Strasburg	Half-long; white; good for summer and fall.
	Celestial or White Chinese	Long; large; white; for winter keeping.
Rutabaga	Improved Long Island	Early; round; very short neck; good quality.
Spinach	Long Standing Bloomsdale	Early; dark green; crinkled; erect.
	King of Denmark	Slowest to shoot to seed; dark green; crinkled; spreading.
	*New Zealand	Not a true spinach; produces throughout summer.
Squash	White Bush Scallop	Early, white, Patty Pan type.
	Giant Summer Straightneck	Yellow, warted, straight.
	*Table Queen	Small; blue-green; acorn-shape; productive; good baker and keeper.
	Delicious	Medium size; midseason; excellent quality
	Hubbard (Green, Golden, Blue, Warted)	Large; late; good quality and keeper.
Swiss Chard	Lucullus	Dark green, crinkled leaf, broad white midribs.
Tomato	Earliana or Canadian	Earliest red; poor quality; rough.
	*Bonny Best or John Baer	Early; round; smooth; red; productive.
	Marglobe	Midseason; large; deep-fruited; red; disease-resistant.
	Early Detroit	Early; round; pink or purple color.
	Globe	Midseason; deep-fruited; pink or purple color.
	Early Stone and Greater Baltimore	Midseason-late; red; for canning.
Turnip	Purple Top White Milan	Early; flattened; good quality.
	Purple Top White Globe	Main crop; round; good quality.
Watermelon	Harris' Earliest	Early; oblong; black seed.
	Halbert Honey	Medium early; long with blunt ends; (Imp. Kleckly Sweet).

*Especially recommended for home gardens.

SOIL NITRATES AS A GUIDE TO THE NITROGEN NEEDS OF VEGETABLE CROPS

H. D. BROWN

Quickly determined and accurate indices of nitrogen starvation have long been sought in all endeavors concerned with plant production. Such indices are especially valuable because remedial measures in the form of quickly available nitrogenous fertilizers can often be applied in time to be of benefit to growing crops. Measures of this kind are doubly important to many commercial vegetable gardeners because their greenhouses and many of their gardens are equipped with irrigation systems, thus enabling them to make use of surface applications of soluble nitrogenous fertilizers even though desired rains fail.

Light colored to yellow foliage and stunted plants are generally considered as typical symptoms of nitrogen starvation. Diseases and insects also frequently cause similar symptoms and confirmation tests are desirable.

Diphenylamine, in varying strengths of sulphuric acid, has long been used as a qualitative measure of the nitrate-nitrogen content of plants. A new technique for using diphenylamine to determine the nitrate-nitrogen content of soils and plants has been developed by Dr. M. Francis Morgan of The Connecticut Agricultural Experiment Station[1]. This method is rapid and quite accurate; the amount of nitrate nitrogen in the sample is determined by the shade of blue color developed when 4 drops of the diphenylamine reagent are added to one drop of the solution to be tested.

Many interesting results were secured during the 1930 season by means of this test. Tests made during the spring and early summer indicated that the tomato and cucumber crops growing in supposedly rich soils in our University greenhouses were starving for nitrogen. In many instances the nitrate-nitrogen content was reduced as low as 1 to 7 p. p. m. The color of the foliage and shape of cucumber fruits also indicated lack of nitrogen. Evidently nitrogen is not liberated from so-called rich greenhouse soils fast enough for spring and summer cucumber and tomato production. This statement has been varified repeatedly by Mr. I. C. Hoffman at the Ohio Agricultural Experiment Station at Wooster. Tests were also made where the soil had been allowed to dry. In spite of the

[1]Science, LXXI: No. 1839, p. 343. 1930.

fact that the dry soil was in many instances only a few inches from moist areas it was found that the dry soils often contained 20 or more p. p. m. of nitrate nitrogen. This difference is thought to be due largely to the removal of the nitrates from the moist soil by plant roots as an excess of water was not used and so little could have been lost by leaching. During the fall and winter, on the other hand, the nitrate content of soil and plants was always high; i. e., 20 p. p. m. or more. This is no doubt partly due to the fact that the plants were unable, owing to the lack of light, to manufacture sufficient carbohydrates for the utilization of the nitrates. It is obvious that during such times a better balanced plant would result if the nitrate supply in the soil could be lowered. It is estimated that 7 p. p. m. of nitrates are sufficient for cucumbers and tomatoes and 15 p. p. m. for leafy vegetables in the fall but that 20 or more p. p. m. should be supplied in the spring and summer.

The nitrate content of fresh strawy manure was tested many times and seldom found in excess of 5 to 7 p. p. m. The utilization of the excess soil nitrates by fall applications of strawy manure is, therefore, suggested as a possible means of reducing the nitrate supply of rich greenhouse soils during the fall and winter. Of course, manure from animals fed leguminous crops should not be used for this purpose as it would contain more available nitrogen. The relation between the nitrate-nitrogen content of manure and soils is a problem that must be given considerable thought; for instance, strawy manure should always be applied and plowed under in the fall if the land is to be utilized the following spring for the production of leafy vegetables. Even though the manure is plowed under in the fall it is likely that well-rotted manure rather than strawy manure should precede leafy vegetable crops.

On June 11 it was noted that a well-mulched, irrigated rhubarb crop in the University gardens was making a poor growth. The soil and manure mulch each contained less than 7 p. p. m. of nitrates. One-half of the rhubarb was fertilized at the rate of 500 pounds per acre of 16% nitrate of soda, and on July 11, when the nitrated half was making a much better growth, the soil receiving the fertilizer contained from 15 to 20 p. p. m. of nitrates, while the unfertilized plot contained approximately 1 p. p. m.. This is a concrete illustration of the effect of a corrective treatment on a perennial grown under irrigation.

On May 10 it was noted that spinach which had been planted on March 12 was making a poor growth and showed symptoms of nitrogen starvation. A portion of the crop which was irrigated

was given a surface application of nitrate of soda at the rate of 300 pounds per acre. A few days later the surface soil which had received the nitrate tested approximately 60 p. p. m. of nitrates and the unnitrated plot tested only 15 p. p. m. The nitrated spinach was making a much better growth. Apparently, 15 p. p. m. of nitrates is not sufficient for the best growth of spinach even on this highly manured plot of ground. Rotted manure at the rate of approximately 30 tons per acre had been plowed under the preceding fall. It is also obvious that a nitrate concentration of 60 p. p. m. did not injure the spinach. It is interesting to note in this connection that the surface soil on the nitrated plot was always more moist early in the morning than on the plot not nitrated. This difference, however, soon disappeared after irrigation was started and it is felt that the yield increase which in this case was triple that of the check plot was due directly to the added nitrates rather than to the attraction of moisture by the hygroscopic Chilean nitrate of soda. Spinach probably requires a nitrate-nitrogen level of 30 p. p. m. for best growth. It is also of interest to know that the spinach which grew on the non-nitrated plot never produced marketable foliage.

A little later in the summer a planting of spinach was observed on a rich garden soil near Cincinnati. This crop was planted under an overhead system of irrigation and the gardener was greatly surprised to learn that the soil did not show even a trace of nitrates. He thought that the stunted spinach, which was almost devoid of green color, was suffering from some disease. In this instance the lack of nitrates may have been due, partly, to competing microorganisms which were doubtless actively decomposing the abundant supply of strawy manure and, partly, to the loss in drainage waters brought about by excessive irrigation.

A crop of late cauliflower, growing on the University gardens, which had made a good foliage growth, ceased to grow rather abruptly and did not form heads. The foliage was rather light green in color and tests were made to confirm the nitrogen starvation symptom. It was found that the soil contained only 3 to 5 p. p. m. of nitrates whereas the soil, adjacent to the cauliflower, planted to head lettuce, which had not made a very luxuriant growth, contained 20 to 30 p. p. m. Evidently the cauliflower had depleted the nitrate supply as both plots of ground had received the same fertilizer treatments. Nitrate of soda applied to a portion of this cauliflower crop supplied sufficient nitrogen for the formation of good heads although the application was not made until Septem-

ber 20. The plot not nitrated matured a reduced number of heads, many of which were too small for market. From this it is evident that nitrates can be applied profitably, in some instances at least, for fall crops.

The results of the 1930 nitrate tests under field conditions where water could not be applied artificially were far from satisfactory. A gradual accumulation of nitrates occurred on even poor soils as the drouth became more severe. This accumulation was no doubt due to the fact that nitrates were being made available even though the soil was too dry for crop growth, and, since the nitrates were neither washed away nor removed by the plants, they accumulated.

Rye was planted about September 15 on all but a limited area of each of 27 experimental plots used for fertilizer tests at Columbus. On November 8 nitrate tests were made from areas in each plot covered and not covered with rye. The average for the 27 rye-covered plots was 18 p. p. m. and that for the 27 areas only a few feet away in each instance was 29 p. p. m. The results of these tests were used to indicate the time when the nitrates had been used by the rye as the plots were fall plowed, as soon as most of the nitrates were utilized, to roughen the soil surface in order to facilitate the absorption of any moisture which might fall.

It is obvious from the foregoing that the quickly-made diphenylamine test for nitrates has great value.

THE USE OF MANGANESE IN VEGETABLE GREENHOUSES

I. C. HOFFMAN

Manganese is one of the newer fertilizer elements that appear to be required for normal plant growth. The plants do not need it in large quantities, but some is necessary for proper development. When the soils in which they grow are well supplied with all of the necessary elements, plants have a particular shade of green that is recognized as normal.

Deficiencies in certain of these elements may result in modifications of this color, usually manifested by lighter shades of green in certain parts of the plant. The variation in color depends upon the degree of the deficiency of the element. In extreme cases, the

green color of certain parts of the plant may almost wholly disappear; this color change is known as chlorosis, the chlorotic pattern depending upon the element that is absent or deficient. Chlorosis is usually caused by a lack of nitrogen, iron, or manganese, although it may also be induced by inadequate supplies of potassium, calcium, magnesium, and, possibly, other elements.

MANGANESE DEFICIENCY IN GREENHOUSE SOILS

Manganese chlorosis has been recognized in vegetable crops by scientific investigators for a long time, but, outside of pot cultures, it does not seem to have been reported in vegetable greenhouses. Within the last two years, several well-defined cases have occurred in Ohio greenhouses in tomatoes and cucumbers. The effect upon the plants was typical and the chlorotic pattern was very characteristic of the trouble.

The soils in which the deficiency occurred varied considerably in type. In each case, however, the soils were originally slightly acid but had later been neutralized by heavy applications of lime. The first case observed was on a tomato crop in a greenhouse at Toledo, Ohio. The house had been in use for a number of years in the production of leaf lettuce. Large quantities of manure and lime had been applied regularly as a cultural practice during most of this period, but in late years the cropping system had been changed to spring tomatoes and fall and winter flowers. The soil, for the most part, was a dark loam containing considerable sand, with sand predominating in certain portions. In these sandy portions, the tomato plants did not grow well, and upon examination they were found to be chlorotic and stunted. The mottled appearance of the leaves suggested a manganese deficiency. When manganese sulfate was applied as a top-dressing, the plants regained their normal color and resumed their growth in 4 or 5 days. Similar conditions were observed in two or three other greenhouses in the same district, and when manganese was supplied the chlorosis disappeared as in the previous case.

In the Cleveland district several cases of manganese chlorosis have occurred in tomatoes. The first and worst cases noted were in separate ranges but it so happened that both ranges were located upon the same sandy ridge. The soil in both cases had been treated liberally with manure and lime for leaf lettuce, but tomatoes were being substituted as the spring crop. When these houses were observed in the spring of 1929, the tomato plants were in a most severe chlorotic state. The plants had grown to a height

of about 4 feet and then gradually stopped. Almost every plant was a golden yellow color in the upper portions, and no fruit was setting; in fact, the buds were dropping off before they opened.

Fig. 1.—The top of a tomato plant, growing in a greenhouse, showing extreme chlorosis due to lack of manganese. Note the stunted condition of the plant and the dropping of the blossom buds before opening.

Manganese sulfate was applied to the soil as a top-dressing and irrigated in. The plants began to recover in 5 or 6 days, and within a week to 10 days the green color had returned, normal blossoms developed in the new growth, and fruit of good quality eventually matured. In 1930, tomatoes in these same houses developed a good crop with almost no signs of the former trouble, although the chlorosis did develop in a section of the range that did not receive manganese in 1929. Mild symptoms of manganese deficiency have developed on clay and clay-loam soils in other greenhouses where tomatoes were growing this year. These soils had been very heavily manured and, for the most part, they had also been liberally treated with ground limestone. The reaction of the soil was between pH 7.4 and 7.6 as determined with a LaMotte soil testing outfit.

Two cases were noted this year (1930) where spring and summer cucumbers had developed serious manganese chlorosis. One case was on sandy soil and the other on a medium clay loam. Manganese sulfate was applied to the sandy soil and the chlorosis almost wholly disappeared within 10 days. It was not applied to the clay soil and the crop was very light as a result. The color remained light to the end of the season and few fruits were set.

SYMPTOMS

The symptoms of manganese chlorosis are progressive in their appearance. The trouble may show in the plant at any stage of its development. The first signs of the trouble develop in the tops of the plants as a stunting; they consist in a slowing up of the growth so that the stem of the plant becomes slender and the foliage remains small. At the same time the color changes to a lighter shade of green, and a mottled appearance, that suggests a mild form of mosaic, develops. The green color rapidly disappears from the web of the leaf but remains in the larger veins until they appear as green lines upon a golden yellow background. In the final stages, small whitish specks of dead cells appear in the centers of the areas bounded by the green veins (Fig. 2). The blossom buds often fall without opening, and the whole plant may appear ready to collapse and die. The young tip shows the trouble first and then it progresses downward throughout most of the plant. In some cases a peculiar double branching may occur in the top of the tomato plants, that seems to be associated also with a lack of manganese.

Fig. 2.—Leaflets of tomato plants showing the color pattern caused by a lack of manganese. Note the small dead spots in the centers of the yellow spots

In cucumbers the effect is similar to that of tomatoes. The chlorosis progresses from the tips of the plants downward. The yellowish-colored leaf with its outstanding green veins presents a picture that is easily remembered when once seen. Figures 3 and 4 show a single leaf and an entire cucumber plant, respectively, that are badly chlorotic.

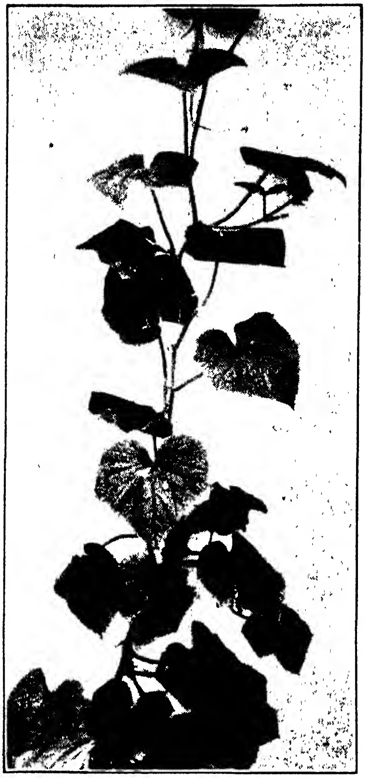
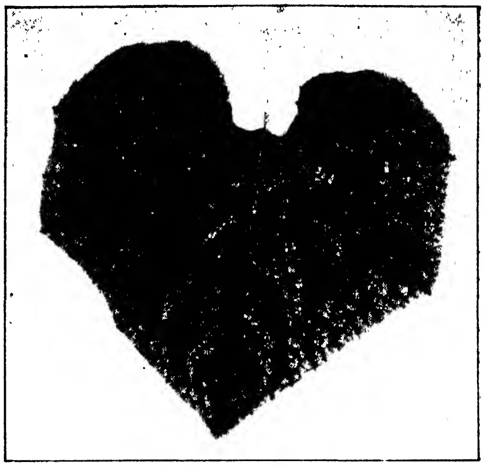


Fig. 3.—A greenhouse cucumber plant showing the effects of a lack of manganese. Such plants grow slowly, have few laterals, and bear little fruit. This plant had received an application of manganese sulfate and the chlorosis has been corrected in the top of the plant.



manganese. Note that the green color remains longest near the larger veins.

CORRECTING THE TROUBLE

Manganese sulfate is easily obtained and, for this reason, it is suggested as a source of the element. Other forms may be used whenever available. There is no longer any doubt that manganese is necessary as a nutritive element in plant growth. While only a small quantity is required, it becomes a limiting factor if the supply is deficient. In soils that have been neutralized by lime, it seems to produce the best results if the manganese is applied as a side-dressing after the crop has been set in the beds and well started. If the soils contain their original acid condition, the manganese may be applied to the soil in advance of the crop. In either case, manganese chlorosis may be prevented and mild cases corrected by an application of 100 to 150 pounds per acre of manganese sulfate. In very severe cases, one or perhaps two supplementary applications may be necessary at intervals of 10 days. In each case described in this paper the trouble was corrected by a single application and the growers estimated increased yields at 10 to 25 per cent over untreated sections.

WHAT MAY BE EXPECTED FROM HYBRID CORN?

G. H. STRINGFIELD

What may be expected from hybrid corn? What does the term "hybrid corn" mean? Any corn plant which is the result of a cross between two unlike parents may be called a hybrid. This would include practically every corn plant the farmer grows because of the promiscuous crossing taking place even within a variety, the individuals of which are a variable lot.

If two varieties, say Reid's and Leaming, are crossed, the progeny may again be called a hybrid. The parents involved in the production of any given plant in such a cross may not actually differ from each other more than would two parents within a single variety, but for convenience the progeny from a cross between recognized varieties may be called a variety-hybrid.

A more important kind of hybrid, however, is produced by crossing what plant breeders call "selfed lines". A selfed line is a population of corn produced by controlling the pollination in such a way that the silks of a given plant are pollinated only by pollen from that same plant. This is inbreeding in its most intense form.

Among human beings the marriage of near relatives is commonly looked upon with disfavor; it is argued, and soundly so, that such marriages add to the hazard of hereditary defects in the children. The same general situation holds in corn except that instead of mating near relatives the plant is actually mated with itself.

After several successive generations of this selfing, populations are produced in which every plant is alike, or very nearly alike, in its heredity. Plant breeders refer to such a population as a selfed line. In the process of inbreeding or selfing many abnormalities appear, such as barrenness, weak stalks, dwarfs, white or yellow seedlings, short husks, ill-shaped ears, or general weakness. These undesirable characteristics are not created by inbreeding but they were potentially present in the stock, only being brought into expression by inbreeding. Thus, these characteristics may be largely eliminated by discarding the plants possessing them from the breeding material.

Even the best selfed lines are usually quite unpromising in appearance and productiveness, but a very interesting fact is learned by crossing unrelated selfed corn plants. The progeny of such a mating exhibits vigor and uniformity. In some crosses among selfs the progeny are more vigorous and have greater yield-

ing capacity than the original corn before any inbreeding was begun. By this process corn yields have been made greater. This general method was first suggested about 20 years ago by Professors Shull, of Princeton University, and East, then at the Connecticut Agricultural Experiment Station.

These hybrids between selfed lines have definite advantages over hybrids between varieties. Hybrids between varieties often yield more than the mean of their parents and may yield somewhat more than the better parent, but numerous tests in Ohio and other states indicate that they have only a very limited place in corn improvement. The likelihood of any varietal hybrid being better than either of its parents is small, and superiority could be demonstrated only by thorough testing. Furthermore, any advantage which might be gained would be limited to the first generation after making the cross.

The hybrids between selfed lines, on the other hand, appear to have much to recommend them, and they have already demonstrated their worth in many places.

The greater yield of such hybrids compared with that of common and time-tested varieties is illustrated in a recent progress report of the Office of Cereal Crops and Diseases. The tests therein reported were conducted in thirteen states, in cooperation with the United States Department of Agriculture. In Iowa, the 1929 tests included 230 entries of hybrids between selfed lines and 236 entries of well-known popular varieties (Reid's, Leaming, etc.), designated as "open-pollinated" to distinguish them from the hybrids. The tests were made in twelve different sections of the State. In every test, a hybrid gave the highest yield, and the average of the hybrids was above the average for the open-pollinated varieties. This difference ranged from 5 to 32 per cent.

In Nebraska, tests were made at four points in the State. Averaging all varieties and all hybrids tested in the various localities, the hybrids yielded 12 per cent more than the open-pollinated varieties.

Kansas, Missouri, Minnesota, Illinois, Indiana, New York, Wisconsin, and Ohio all publish evidence that hybridization among selected selfed lines may be expected in many cases to result in superior yield and quality. Some Ohio results are given in Table 1.

The work in Ohio is yet in a preliminary stage. About 750 selfed lines which have been selfed five or more generations are on hand. About 500 of these are dent corn and 250 are sweet corn. Yield tests of hybrids among these selfed lines are very encourag-

ing. The reaction of these hybrids under corn borer infestation is being studied, and there is now unmistakable evidence that there are marked differences among apparently well adapted strains of corn in their ability to survive corn borer attack with satisfactory yields of grain.

TABLE 1.—Yields of Ohio Open-pollinated Corn Varieties and Hybrids From Various Sources, 1929

The tabulated numbers indicate the number of varieties or hybrids falling into the yield classes designated at the top of the table

Experiment	Kind of corn	Source	Yield in bushels per acre											
			44	48	52	56	60	64	68	72	76	80	84	88
Columbus A	†Open-pollinated	Ohio		2	2	2								
	Hybrids	Illinois			1	1	1							
	Hybrids	Indiana					2		1					
	Hybrids	Misc.				3	1	1						
‡Columbus B	Hybrids	Ohio		3		1								
	Hybrids	Iowa	1	3		3	1	1	1					
	Hybrids	Illinois	2	1	3	3								
	Hybrids	Indiana		1	1	1								
	Hybrids	U. S. D. A.				1	1							
	Hybrids	Misc.		1		2			2					
Wooster A	†Open-pollinated	Ohio						3		4		1		
	Hybrids	Ohio		2	5	3	7	12	19	14	9	15	4	2
	Hybrids	Iowa							2	5	1	1	2	2
	Hybrids	Minn.		1	2	1	3		1					
	Hybrids	Illinois						2	4	1	2			
	Hybrids	Misc.								1	2	1		
Wooster B	†Open-pollinated	Ohio							2	1	1			
	Hybrids	Ohio		2	1	2	7	4	7	4	6	2	1	
	Hybrids	Iowa						2	3	2	4	3		
	Hybrids	Minn.				1	2		1					
	Hybrids	Illinois					3	1		3	2			
	Hybrids	Misc.						1	1	2				

*Each test at Columbus consisted of three series; individual plots were five by eighteen hills. Each test at Wooster consisted of five series; individual plots were single rows, ten hills long.

†Open-pollinated varieties which had given highest yields in previous tests were included in these comparisons.

‡No open-pollinated varieties were grown in the Columbus B test.

What, then, may be expected from hybrid corn? There is very good reason to expect that ultimately corn yields on the farms throughout the corn growing areas will be favorably influenced by it. Furthermore, it appears that special good qualities such as tolerance of the European corn borer and resistance to lodging or to disease can be met more rapidly and effectively by this method of breeding than by any other yet discovered.

There are some disadvantages to this method of corn breeding which, however, are outweighed by its advantages. In the early stages of its use the cost of seed may be expected to be relatively high. But since a bushel of seed corn will plant 6 to 8 acres, an additional seed investment of 2, 3, or 5 dollars per bushel is not

serious, provided the return in yield of corn is greater by from 5 to 15 per cent. The additional cost of seed is occasioned principally by the necessity of using first generation hybrid seed each year because seed taken from a crop produced by planting hybrid seed yields less than the original crossed seed.

One thing that must be borne in mind by prospective purchasers of hybrid seed is that attaching the name "hybrid" to a bag of seed is no insurance of high seed value.

Hundreds of trial crosses between selfed lines must be made in order to identify the relatively few crosses that have merit. The experience in Ohio would indicate that the majority of such crosses are of mediocre or inferior value. The Ohio Agricultural Experiment Station, in cooperation with its District and County Experiment Farms, has begun a system of hybrid and variety tests which give information from 14 locations in the State. An effort is made to include the more important hybrids in these tests and the results are available to the public. Neighboring State Experiment Stations have somewhat similar tests. Farmers are advised to purchase only enough hybrid seed corn to plant a few acres as a local test of yield and adaptation until the results from the Experiment Station tests are available as a guide.

The present supply of hybrid seed is small and should remain so until the existing hybrid combinations are more definitely evaluated. The main corn crop of Ohio and neighboring states will be produced from open-pollinated varieties for several seasons to come. Experience and observation, rather than salesmanship and propaganda, should determine the rapidity of hybrid corn introduction. Those who grow hybrid corn in Ohio must, for a few seasons to come, consider their work as an experiment rather than as an established practice.

In summarizing, hybrid corn may be produced by crossing unlike plants. Hybrids between varieties offer little promise in corn improvement. Hybrids between selfed lines offer considerable promise, both as to higher yields and as to producing corn better able to withstand specific adverse influences, such as the European corn borer and disease. Prospective buyers of hybrid seed may be guided by Experiment Station tests. The usual open-pollinated varieties should be depended upon until experience from small plantings indicates the advantage of hybrids.

GLADIOLUS DISEASES

PAUL E. TILFORD

The gladiolus, until a few years ago, was thought to be relatively free from serious diseases. At the present time, however, several destructive diseases are known to affect this popular flower, and most of the troubles have become distributed to the extent that they are found wherever the gladiolus is grown. This widespread distribution and prevalence of disease has occurred largely through the transportation of propagating stock from one location to another. A new variety of worth, originated in one section of the world, is soon bought by admirers in other sections. As a result of this extensive exchanging, the diseases have become universal.

Gladiolus diseases can be grouped into three classes according to their cause. Scab and bacterial leaf blight are due to bacteria. Hard rot, dry rot, Fusarium rot, and Penicillium rot are caused by fungi; while the mosaic disease is caused by a virus.

BACTERIAL DISEASES

SCAB

Symptoms.—Scab is probably more common than any of the other gladiolus diseases. Some scab can be found in almost every planting. The most characteristic symptom of this disease is the presence of circular, shallow, brown to black depressions on the corms, Figure 1. Several scab lesions may coalesce to form an

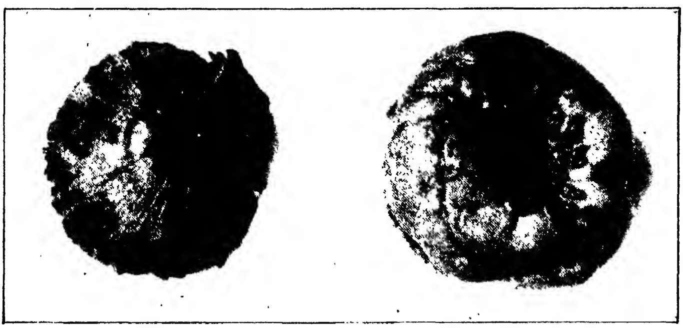


Fig. 1.—Gladiolus scab-corm at left shows lesions on husks; corm at right shows sunken lesions

irregular lesion. The depressions are surrounded by a distinctly raised margin which appears more or less water-soaked. The center of the lesion may appear shiny, as if it were varnished; this

varnished appearance is due to the drying of bacterial exudate. On the husks, scab appears as brown streaks or spots. Often the center of the husk lesions disintegrates, leaving a hole in the husk with a brown, burned-appearing margin exposing the lesion on the corm below. The lower part of the leaves may also be affected. The brown-black lesions may become so numerous and extensive, due to the activity of the bacteria in severe cases, that the leaves are rotted off at the soil. This stage is sometimes called neck rot.

Cause and spread.—The bacteria (*Bacterium marginatum* McCulloch) which cause scab live over from one year to the next on the husks and corms and in the soil. When diseased corms are planted or when disease-free corms are planted in soil contaminated with the scab organism, the bacteria come in contact with the new corms as soon as they are formed and cause the disease. Rain splashes the bacteria on the lower leaf portions and the neck-rot stage may develop. Water is necessary for extensive migration of the bacteria and is also necessary for infection to occur. This explains why scab is more prevalent in wet years and more severe in low spots in a field.

Scab does not spread in storage and seldom progresses in the corm after it has been dug.

Control.—Formaldehyde, mercuric chloride, and organic mercury compounds have been recommended as corm disinfectants.

Experiments were started two years ago at the Experiment Station to determine the most effective and convenient form of corm treatment. Only a few of the most important conclusions will be given.

Formaldehyde in solutions, or when combined with an inert material as a dust, has not been satisfactory. Concentrations of formaldehyde that will control scab are injurious to the corms. The corms are slower to start growing, the plants flower later, and fewer corms are produced.

Semesan, an organic mercury compound, is effective in controlling scab when the corms are soaked in a 1 per cent solution for 7 hours. Treating with Semesan retards the flowering date a few days but does not interfere with corm production.

Soaking the corms for 2 hours in a mercuric chloride solution, 1-1000, is an effective treatment and non-injurious.

Soaking the corms in a suspension of calomel made by mixing 1 pound of calomel with 2½ gallons of water has been very effective.

All organic mercury compounds containing ethyl mercury chloride have proved very injurious.

The most satisfactory form of treatment at the present time is the mercuric chloride treatment. The solution is made by dissolving 1 ounce of mercuric chloride in a small amount (½ gallon) of hot water and then diluting to 7½ gallons. A wood or crock container must be used since mercuric chloride reacts chemically with metals. The corms are soaked in this solution for 2 hours. The solution decreases in strength and it is necessary to add ⅓ of the original amount of mercuric chloride after treating each lot of corms to bring it back up to par. Enough water should be added to bring the quantity up to the original amount. Even with this precaution, the solution should be discarded after it has been used 7 or 8 times and a new one made up. If large quantities of corms are treated, barrels may be used. Thirty gallons of solution can be made up in a barrel; this is enough to treat about 4 bushels of corms at a time. If small quantities of corms of several varieties are to be treated at the same time, each variety may be tied in a cheese cloth bag and labeled. It is best to treat before the corms have started growth. The corms may be planted immediately after treating or, if they are dried, they may be put back in storage.

Mercuric chloride is a deadly poison and must be used with care.

The treated corms should be planted in soil that has not grown gladioli for at least 4 years. The scab organism remains alive in the soil for long periods of time and if the treated stock is planted in contaminated soil there can be no benefits from the treatment.

BACTERIAL LEAF BLIGHT

Symptoms.—This disease is a leaf blight and does not affect the corm, except that smaller corms are formed when many of the leaves are injured or killed. Early symptoms appear as water-soaked spots on the leaves. These spots enlarge the long way of the leaf, thus forming more or less square or rectangular lesions. Several lesions may unite and involve the entire leaf. When the blighted areas become old and dry, they turn brown and the leaves may be killed entirely. Considerable quantities of bacterial slime exude from the blighted leaves. Under moist conditions a sticky film is formed over the leaf to which soil and dust particles adhere. The disease is usually worse in young stock than in mature plants and is more severe during wet years and in low, wet spots in a field.

Cause.—Leaf blight is caused by a bacterial organism known as *Bacterium gummisudans* McCulloch.

Control.—Spraying young stock with bordeaux mixture as suggested for hard rot should control leaf blight.

FUNGOUS DISEASES

HARD ROT

Symptoms.—The symptoms of hard rot are not as clear cut as those of scab, and it is often impossible to distinguish hard rot from dry rot without making a laboratory diagnosis. This is especially true in the early stages of the disease. Somewhat circular to irregular sunken lesions form on the corms, Figure 2. These are dark brown in color and at first can not be seen until the husks are removed. The rot progresses until the whole corm is mummified. Hard rot does not spread in storage but does progress in individual corms.

Fig. 2.—Hard rot

Hard rot also affects the leaves. The leaves of small plants grown from seed or from cormels are more often affected than leaves of large plants grown from corms. Small circular spots are formed on the leaves and in the center of these spots are numerous, minute, black bodies. These are the fruiting bodies of the fungus and contain the spores.

If corms are planted which are only partly rotted the plants may appear normal for a while, then, perhaps, when they are half grown the leaves will begin to die at the tips and later the whole plant will die.

Cause and spread.—Hard rot is caused by the fungus, *Septoria gladioli* Pass. It over-winters in the corms and in the soil. The spores are splashed by rain from diseased to healthy plants and then, if plenty of moisture is present, infection occurs.

Control.—Treatment is ineffective for hard rot, since the organism is inside the corm and treatment only disinfects the surface. Carefully sorting the corms and discarding all that show any evidence of rot is fairly effective. Sometimes it is necessary to remove the husks to detect small hard-rot lesions. If only a small quantity of corms is to be planted, they should all be husked and inspected closely for hard rot. Where large quantities are handled the inspection should be as critical as is feasible.

Since the hard-rot fungus lives in the soil for a long time, rotation is essential for hard-rot control the same as for scab control.

Spraying small plants from seed or cormels with bordeaux mixture is advisable at about 10-day intervals. Potash fish oil soap should be added to the spray for a spreader, at the rate of 1 ounce to 1 gallon of spray.

DRY ROT

Symptoms.—It has already been pointed out that it is difficult to distinguish dry rot from hard rot on the corms, especially in the early stages, without making a laboratory diagnosis. The lesions of dry rot do not have as distinct a margin as those of hard rot and they enlarge more rapidly, Figure 3. Finally, the whole corm is turned to a black mummy much the same as with hard rot. Sometimes small, pin-head sized, black bodies can be seen on the rotted corms. These are produced by the dry-rot fungus and are called sclerotia. Sclerotia are never present with hard rot.

When corms slightly affected with dry rot are planted, the young plants appear normal but later the leaves die from the tip back until the whole plant succumbs.

Cause and spread.—Dry rot is caused by the fungus, *Sclerotium gladioli* Massey. It is like the hard-rot fungus in that it lives over winter in the corms and in the soil. The sclerotia are able to remain dormant for long periods of time and then start to grow when conditions are favorable. Dry rot does not spread in storage but does progress in the corms already infected.

Control.—The same as that for hard rot.

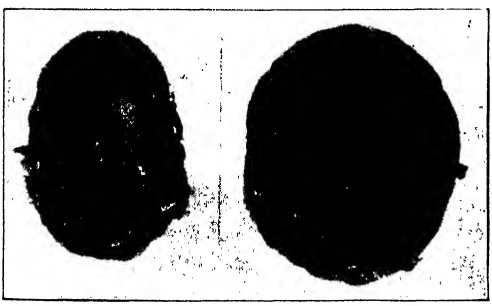


Fig. 3.—Dry rot

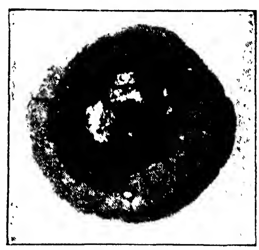


Fig. 4.—Fusarium rot

FUSARIUM ROT

Symptoms.—Fusarium-rot symptoms are first noticed as small reddish-brown spots with water-soaked margins on the corms. In storage, if the temperature and humidity are high, the rot progresses rapidly and soon reduces the corm to a black mummy, Figure 4. The husks may show discolored and brittle areas where the fungus has attacked them.

If diseased corms are planted, weak plants which die prematurely will be produced, or the corms may rot after they are planted, in which case no plants will be produced at all.

Cause and spread.—This rot is produced by a fungus belonging to the group known as Fusarium. This group of fungi is very common in nature and contains several species which cause some of our most serious plant diseases. The fungus lives over winter in the corms and in the soil.

Control.—The same as for hard and dry rots.

PENICILLIUM ROT

Symptoms.—This rot seems to be largely a storage trouble, gaining entrance through injuries to the surface of the corm. Uninjured corms are not attacked. Penicillium rot causes large sunken areas in the corm, which is usually covered with a yellow fungous growth, Figure 5. Close examination reveals numerous egg-shaped, tan bodies in the rotted tissue. These are the sclerotia of the fungus. In some cases, the whole corm is rotted but usually only a part of the corm is affected.

Fig. 5.—Penicillium rot. Note small sclerotia in rotted portion

Cause and spread.—This disease is caused by the fungus, *Penicillium gladioli* McCulloch and Thom. Infection probably occurs through injuries at digging time. It is worse when the corms are not rapidly dried as soon as they are dug. Occasionally growers find it necessary to wash the corms to remove the dirt when it has been wet at digging time. This operation seems to encourage Penicillium rot.

Certain varieties are much more susceptible than others. Alice Tiplady is perhaps affected more than any other variety.

Control.—Care should be used at digging time to injure the corms as little as possible. They should be dried rapidly after they are dug. The storage should be kept dry, and the temperature should not go above 45° F. Sorting out of diseased corms and following a rotation are just as important in controlling this disease as they are in controlling hard rot or dry rot.

VIRUS DISEASE

MOSAIC

The mosaic disease of gladioli was not observed until recently. Diseases of this type, however, are very common on a great number of plants. Leaves of diseased plants show a distinct mottling—dark green and light green areas. They are dwarfed and produce smaller flowers; the flower petals show the effects of the disease by failing to develop normal color. The corms have a distinct rough and warty appearance.

Since this is a fairly new disease not much is known regarding its control. In sorting the corms, however, all that show the warty condition should be discarded.

SUMMARY

There are several serious and widely distributed diseases of the gladiolus. Most of these troubles can be controlled by sorting the corms and discarding all that show symptoms of hard rot, dry rot, Fusarium rot, Penicillium rot, and mosaic, and then treating before planting by soaking the remaining corms in mercuric chloride (1 ounce to 7½ gallons of water) for 2 hours.

When hard rot or bacterial leaf blight develop on the leaves it is advisable to spray with bordeaux mixture, to which soap has been added for a spreader.

Corms should be handled as carefully as possible at digging time to prevent injury and they should be dried rapidly after they are dug.

The storage should be kept fairly dry and the temperature should not go above 45° F.

A rotation should be followed in which gladioli are not grown on the same soil more than once in four years.

THE RELATION OF FOOD TO THE GROWTH OF PRE-SCHOOL CHILDREN

MARY ANN BROWN

The importance of food as a factor in the growth of children is generally recognized. Certain foods are considered essential. In connection with a study of the seasonal variation in the rate of growth of 114 pre-school children in Ohio, records of their food habits were kept. In order better to estimate the value of these diets, it was found helpful to measure them by an optimum score.

Miss Mary E. Frayser, member of the Home Economics staff of the South Carolina Agricultural Experiment Station, has formulated such a score after consultation with several well known nutritionists[1]. Miss Frayser used this score in the study of the diets of 541 pre-school children in South Carolina[2]. The score is as follows:

Food	Standard	Optimum Score
Milk	One quart a day	40
Eggs	Four times a week	15
Vegetables: Leafy, and other than potato or leafy	Average of 1½ servings per day	15
Vegetables: Potato	Once a day	5
Fruit: Cooked, raw, or tomato juice	Twice a day	15
Cereals	Average of 1½ servings per day	5
Bread	Average of 1½ servings per day	5
		100

According to this score the generally accepted amount of milk, a quart a day, is considered standard for a growing child. This amount is valued at 40 points of a possible 100 for the entire diet.

In order to meet the standard and score the optimum of 15 points, a child should eat eggs four times a week.

The daily consumption of one and one-half servings each of a leafy vegetable, such as lettuce, spinach or cabbage, and another vegetable, such as carrots, adds 15 points to a child's score. For a serving of potato once a day he receives 5 points.

The standard amount of fruit is two servings a day, one cooked and one uncooked. Tomato juice, either fresh or canned, may be substituted for the uncooked fruit. Less than this amount of fruit means a reduction of the optimum score of 15.

One and one-half servings each of bread and cereals add 5 points for each or a total of 10 points for both.

A diet which included at least one and one-half pints of milk per day and which had a total score from 80 to 100 was considered adequate by Miss Frayser. With less than this amount of milk no diet was considered adequate. Any diet with a final score from 60 to 80 was questionable as to adequacy. A diet which scored below 60 was definitely inadequate.

[1]Dr. H. C. Sherman, Dr. M. S. Rose, Dr. E. V. McCollum, Dr. Lydia Roberts, and Dr. Edith S. Davies.

[2]Bulletin 260, South Carolina Agricultural Experiment Station. 1929.

Information concerning the diets of the 114 children observed in the Ohio study was secured from the mothers or persons in charge of the children. Their reports were made monthly for a period of at least one year for each child; for 22 children the reports were made for a period of two years. The 114 children were divided into two groups based on different economic levels. One hundred of these children were members of families having at least average income, and the parents were above the average in intellectual training. More than four-fifths of this group of 100 children attended nursery school or kindergarten during a part of the year. These 100 children will be termed Group I.

The remaining 14 children came from a group of lower income level. These children (Group II) were all subject to the same environmental influences and all had the same quality of food.

The majority of the children of Group I received a quart of milk per day. Eggs were used in their diets from three to four times a week either as soft cooked eggs or in custards and other egg dishes. Fruits and vegetables were used in satisfactory amounts throughout the year. Those children attending nursery school or kindergarten were given orange juice or tomato juice at school each day and very often had additional orange juice at home. Cereals and bread were used daily by the children of this group and the consumption met the standard of one and one-half servings in most cases. The diets of the children in Group I scored from 80 to 100, and their diets, therefore, may be classed as adequate.

In like manner, the diets of Group II were compared with the same score. The children of this group received about one pint of milk a day; so, even if all other items of the diet received a perfect score, the adequacy of the diets would be questionable. Eggs were used in standard amounts during the greater part of the year, although for economic reasons they were used more frequently in the spring and summer months than in the winter when the cost was higher. This meant that the average score for eggs was somewhat below the optimum. Vegetables, including potato, were used daily in the diets of these children in standard amounts. A greater variety was used in the summer than at other seasons. Fruits, also, were included in the diets of these children. As with vegetables, fruits were used in greater variety during the summer season than at other times in the year. The children of this group received orange juice only occasionally. Tomatoes were used frequently, but not daily. The experiments of Newell and Miller[3] and Blunt and Chaney[4] show that orange juice has a beneficial effect

[3]Reported in Journal of Home Economics 15: 248. 1925.
[4]Reported in Journal of Home Economics 66: 829. 1925.

upon the growth of children. The score for fruits for the diets of Group II would probably have to be reduced from 15 to about 8 or 10 points. Cereals and bread were used daily in amounts above the average. In fact, an individual dietary study made of this same group of 14 children in 1926 showed the diets to be slightly higher in carbohydrate than might be deemed desirable, due to the large amounts of bread and cereals eaten. In low cost dietaries, it is usually necessary to use cereals in liberal amounts, but certain other foods must be included in satisfactory amounts to make the diet adequate. The total score for the diets of the children of Group II was from 60 to 80 and the adequacy of the diets is questionable.

One hundred and fourteen children were weighed and measured each month over a period of one year. Twenty-two children in Group I were weighed and measured over a period of two years. From these monthly measurements the yearly gains in height and weight were computed for each child.

The children of Group I, whose diets were considered fully adequate when measured by the score card, made an average yearly gain in height of 2.75 inches and in weight of 5.07 pounds. The children in Group II, whose diets were considered only fairly adequate when measured by the same score, made an average yearly gain in height of 2.57 inches and in weight of 3.63 pounds. That is, the children of Group I gained 7 per cent more in height and 40 per cent more in weight than those of Group II. Each group of children made the average expected gain in height and weight. These figures seem to indicate, however, that, although children may make the expected gain on diets which seem to be fairly adequate, an improvement in diet may accelerate growth still more.

From the measurements of the diets of these two groups of children with the optimum score and from a comparison with each other, it seems that the kind of food as well as the quantity may influence the rate of growth. It seems desirable, therefore, to include a quart of milk, vegetables, fruits (both cooked and uncooked), and cereals in the daily diet of the growing child, and that eggs should be used several times a week, since a greater rate of growth was observed for those children whose diets contained these foods than for those children whose diets were lacking in quantity in certain of these foods.

COMPARATIVE PRICES OF OHIO FARM PRODUCTS

J. I. FALCONER

The accompanying table shows a comparison of prices of different Ohio farm products both with each other and with prices of previous years. The commodities have been arranged in the table according to their relative price level during the five years, 1925-1929; for instance, during that period lamb prices averaged 210 per cent above the average for the 1910 to 1914 period. This was the highest comparative level of all the commodities; lambs have, therefore, been placed first, and horses, which averaged in price only 66 per cent of that of the previous period, have been placed last.

It will be noted that during the year 1930, and especially during the latter part of the year, as indicated by the figures for December 1930, there have been many changes in the relative price situation of the individual commodities. Sheep, lambs, wool, dairy items, wheat, and eggs, which for the past few years had helped to maintain the level of Ohio farm product prices, suffered severe depressions in price during 1930. As a whole, during the period 1925 to 1929, inclusive, Ohio farm products sold for prices 53 per cent above the pre-war prices; for the year 1930 they averaged 29 per cent above, but in December of 1930 they were only 12 per cent above. Hay was the only commodity in December, 1930, having a price level above that of 1925 to 1929.

TABLE 1.—Relative Prices of Ohio Farm Products

Item	Units	Average price			Index of price			Dec. 1930
		1910-14	1925-29	1930	1921-24	1925-29	1930	
Lambs	Cwt.	6.05	11.96	8.35	166	210	138	115
Chickens	Lb.	.12	.23	.20	175	196	166	157
Potatoes	Bu.	.77	1.43	1.49	156	192	194	167
Wool	Lb.	.22	.40	.24	171	190	109	104
Butter	Lb.	.25	.44	.38	158	180	152	125
Milk	Cwt.	1.55	2.61	2.25	159	169	145	132
Sheep	Cwt.	4.10	6.51	4.30	126	167	105	95
Milk cows	Head	52.67	82.00	73.00	114	159	139	118
Eggs	Doz.	.22	.34	.26	144	150	118	81
Beef	Cwt.	6.02	8.64	8.28	110	146	137	124
Wheat	Bu.	.96	1.40	.93	124	145	97	80
Hogs	Cwt.	7.62	10.77	9.48	108	145	125	116
Corn	Bu.	.62	.87	.78	118	142	122	125
Oats	Bu.	.40	.45	.40	107	112	100	90
Hay	Ton	14.20	11.64	12.30	93	84	93	123
Horses	Head	163.60	108.00	110.00	64	66	67	62
All Ohio farm products	....	....	....	....	131	153	129	112

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

Among the outstanding happenings of the year 1930 were the decline in prices of farm products and the drouth. Both contributed to a decrease in the agricultural income. In December, 1929, the prices of Ohio farm products averaged 47 per cent above prewar prices; in December, 1930, they were 12 per cent above, a decline of 24 per cent in one year. Income from sales declined from an index of 161 in 1929 to 128 for the year 1930, a decline of 20 per cent for the year.

In December of 1930, Ohio farm products were at the lowest price level since February, 1916; and at the same time the income for 1930 was the lowest since 1916.

Farm wages for 1930 were lower than in recent years.

Trend of Ohio Prices and Wages, 1910-1914=100

	Wholesale prices all commodities U.S.	Weekly earnings N.Y. State factory workers	Prices paid by farmers for commodities bought U.S.	Farm product prices U.S.	Ohio farm wages	Ohio farm real estate	Ohio farm product prices	Ohio cash income from sales
1913	102	...	100	100	104	100	105	100
1914	100	100	101	102	102	102	105	107
1915	103	101	106	100	103	107	106	110
1916	130	114	123	117	113	113	121	121
1917	181	129	150	176	140	119	182	198
1918	198	160	178	200	175	131	203	243
1919	210	185	205	209	204	135	218	266
1920	230	222	206	205	236	149	212	242
1921	150	203	156	116	164	134	132	136
1922	152	197	152	125	145	124	127	136
1923	156	214	153	135	166	122	134	149
1924	152	218	154	134	165	118	133	150
1925	161	223	159	146	165	110	159	164
1926	154	229	156	136	170	105	155	176
1927	149	231	154	131	173	99	147	163
1928	153	232	156	139	169	96	154	147
1929	151	236	155	138	169	94	151	161
1930	135	...	...	117	154	90	129	128
1929								
January	152	234	156	133	166	...	144	149
February	151	236	156	136	...	...	149	143
March	153	239	156	140	...	94	155	151
April	152	237	155	138	163	...	150	150
May	150	236	155	136	...	...	152	147
June	151	236	155	135	...	...	153	160
July	154	235	154	140	172	...	157	207
August	153	237	154	143	...	...	159	187
September	153	240	154	141	...	...	153	171
October	151	237	154	140	174	...	151	162
November	148	233	154	136	...	...	149	154
December	148	234	154	135	...	...	147	155
1930								
January	146	234	153	134	158	...	141	155
February	144	231	152	131	...	...	137	124
March	142	235	151	126	...	90	132	133
April	142	231	151	127	158	...	136	140
May	140	228	150	124	...	...	132	129
June	136	227	150	123	...	...	131	134
July	132	224	149	111	155	...	123	114
August	132	224	149	108	...	...	125	119
September	132	227	149	111	...	...	129	122
October	129	220	149	106	147	...	125	130
November	126	215	149	103	...	...	122	123
December	124	...	...	97	...	...	112	114

NEW MONOGRAPH BULLETINS NOT PREVIOUSLY ANNOUNCED

No. 456. The Cost of Developing an Apple Orchard, C. W. Ellenwood. An analysis of the cost items in developing an orchard of Stayman and Delicious trees under two systems of management over a period of fifteen years is presented.

No. 457. Oriental Fruit Moth Investigations in Ohio. I, L. A. Stearns and R. B. Neiswander. The results to date of an investigation of the oriental fruit moth in Ohio are presented; these include both the findings as to population and as to control.

No. 458. Some Factors Affecting the Movement of Ohio Wheat, L. G. Foster. Data are given on the carlot movement of wheat, including markets, freight rates, discounting, holding, and grading.

No. 459. Taxation as Related to the Property and Income of Ohio Farmers, H. R. Moore. Data presented in this bulletin include comparisons of taxes with total income from Ohio's agriculture, relationship of property taxes to the income from property, variation in income, and the distribution of the farm tax burden.

No. 460. Ohio Agricultural Statistics for 1929, G. S. Ray, A. R. Tuttle, and R. E. Straszheim. Estimates of acreage, yield per acre, and total crop production, number of livestock on farms, and prices of crops, livestock, and livestock products, based on reports of the Federal State cooperating crop and livestock reporting service, are given.

No. 461. The Control of Celery Blights, J. D. Wilson and A. G. Newhall. The causes of the three blights of celery are given, together with the results of experiments with various seed treatments, sprays, and dusts for control.

No. 462. Rate of Planting Potatoes With Some Reference to Sprouting Habit and Size of Plants, John Bushnell. Experiments are reported on the most economical rate of planting potatoes, on size of resulting tubers, on spacing of hills, and on size of seed piece.

No. 463. Molasses in Ration for Fattening Calves, Paul Gerlaugh. The efficiency of cane and beet molasses for producing growth and gains in fattening calves was tested in the experiment reported herein.

No. 464. **Apple Aphids in Ohio,** C. R. Cutright. Data are presented on the population, biological nature, and control measures of the various kinds of apple aphids found in Ohio.

No. 465. **Basal Metabolism of Young Women,** Hughina McKay. Comparisons of the correlations of height, weight, age, and surface area with basal metabolism in young college women are given.

No. 466. **Relation of Nitrogen Fertilizer to the Firmness and Composition of Strawberries,** J. S. Shoemaker and E. W. Greve. The results of certain physical tests, physiological and chemical determinations, and yield comparisons are presented in relation to the effects of nitrogen applications on the firmness and composition of strawberries.

No. 467. **Movement of Open Country Population in Ohio,** C. E. Lively and P. G. Beck. The factors, determined from 1275 households, affecting the family aspect of mobility of open country population are presented and studied in detail.

No. 468. **Family Living Expenditures on Ohio Farms,** C. E. Lively. Information with respect to size of family, income, and other relevant factors, secured from 187 account-book records for the years 1926 to 1928, is given.

No. 469. **The Development of Market Milk Areas in Northeastern Ohio,** C. G. McBride. The influence of new methods of transportation, of growth of cities, of health regulations, and of cooperative marketing on the development of market milk areas is traced and studied.

No. 470. **Forty-ninth Annual Report.** An exhaustive report of the activities of the Experiment Station for the year 1929 to 1930 is given. Also, the work of the individual departments is reported in full. The experiments with soils include fertilizer treatments, liming, soil character, and Ohio state soil survey. Crop tests include inoculation, breeding, culture, and fertilization. Sprays and dusts for control of the many plant diseases and insect pests are discussed in the light of new experiments. Progress in control of insect pests by other means, such as natural enemies, is reported. The fruit studies include thinning, pollination, fruit setting, culture, fertilization, spraying and dusting, pruning, and development of new varieties. Vegetable strain tests and flower experiments are also reported. The forestry activities include land acquisition, tree planting, production of nursery stock, and fire control. The animal experiments reported were along the lines of rations, disease control, breeding, nutrition, and housing and care. Weather data for the year and the financial summary are also included. Persons interested in particular fields will find this an invaluable source of information. The report will be sent on request.

The Bimonthly Bulletin

May-June, 1931 Number 150

Ohio Agricultural Experiment Station

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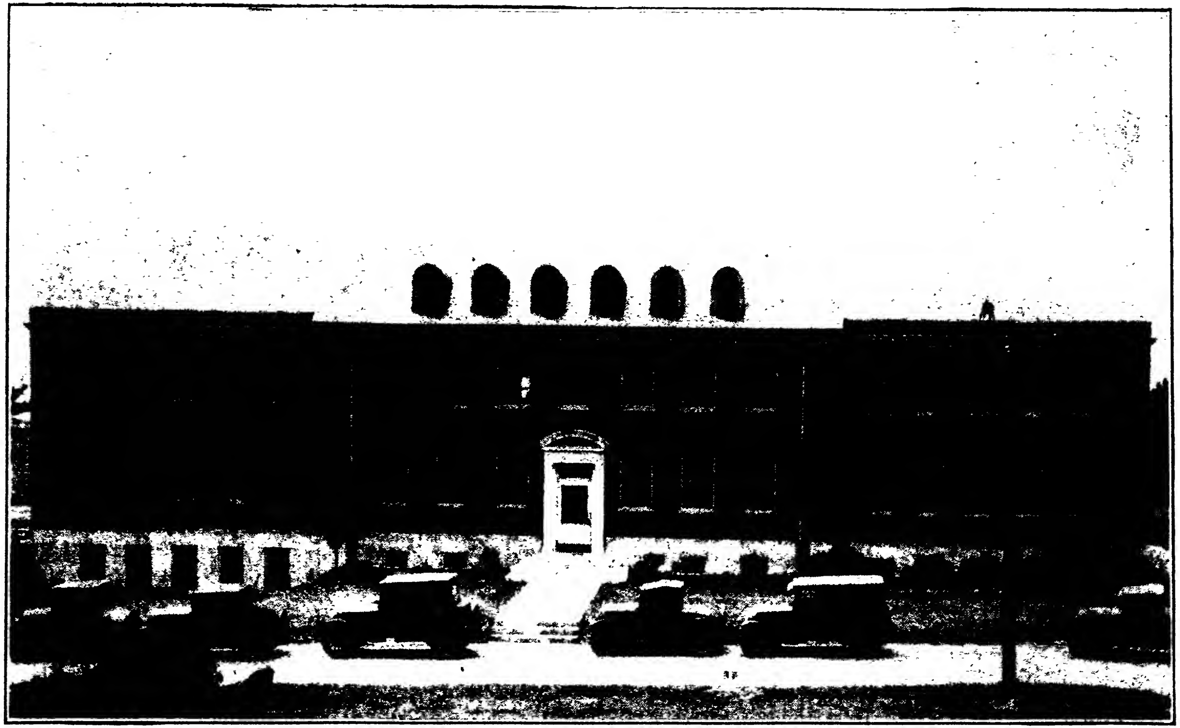
WOOSTER, OHIO, U. S. A.

Free Bulletin

C. G. Williams

Director



Thorne Hall at the Ohio Experiment Station. Home of the Agronomy, Botany, Entomology, and Printing Departments

PULLORUM DISEASE

ALVIN BROERMAN

The destructive nature of pullorum disease, or bacillary white diarrhea, is recognized by many poultrymen. Its economic importance has attracted the attention of investigators and attempts have been made during recent years to control and prevent this widespread disease of poultry.

This disease usually affects baby chicks but causes occasional losses among mature fowls. In baby chicks it is generally an acute, highly fatal, septicemic disease. In adult hens the infection usually localizes in the ovary, and the disease assumes a chronic form.

Pullorum disease is caused by the bacterium, *Salmonella pullorum*. This organism can be distinguished from other closely related bacteria by certain specific characteristics. Usually, it is possible to determine definitely the presence of this infection in fowls by a bacteriological examination.

THE DISEASE IN CHICKS

The infection generally manifests itself a few days after hatching and deaths may occur at that time and continue for three or four weeks.

Most outbreaks of this disease can be traced directly to the presence of infected hens in flocks from which eggs for hatching are obtained. Not all the eggs from diseased hens harbor the infection. Many infected eggs fail to hatch, as the infective agent of pullorum disease is apparently able to kill the developing embryos. However, should one or more chicks harboring the disease be hatched, the others of the brood will soon become infected as the infected chicks become a source of spreading the disease in the incubator. The spread among chicks in the incubator is mainly through down and dust. In many instances the infection is probably acquired by inhalation. The infected chicks also discharge the organisms in their feces, contaminating the litter, feed, and water in the brooder, and thus the disease may be spread to other chicks which were not infected through the egg or in the incubator. Another source of infection is through incubators and brooders that were previously occupied by diseased chicks.

The greatest danger of infection is during the first days of life. The chicks apparently do not develop the acute form of this disease when exposed to the infection after the fourth day. When very

young chicks are fed cultures of *Salmonella pullorum*, they generally develop symptoms of the disease and usually die. The period of incubation is from four to ten days.

Many of the infected chicks die and those that recover may become carriers. Usually about 25 per cent of the chicks which recover retain the infection. Pullorum disease perpetuates itself mainly by being transmitted from the infected hen through the egg to the chick; the recovered chick later produces infected eggs.

SYMPTOMS IN CHICKS

Chicks from infected eggs show symptoms soon after hatching. In some cases the chicks die and reveal few symptoms. Those that live for a few days eat little or nothing, huddle together, and have a sleepy attitude. The wings droop, the chicks appear dejected, and remain under the hover much of the time. A thin, whitish bowel discharge soon appears, which on drying forms chalk-like material, usually closing the cloaca—a condition frequently spoken of as being "pasted up behind". A peculiar cry is often heard when the droppings are voided, and the chicks chirp or peep continuously. In many cases the abdomen appears large, the back short, and lameness is often seen when the chicks attempt to walk. The symptoms of pullorum disease are not sufficiently characteristic to distinguish it from other bowel troubles, and a bacteriological examination is necessary to make a diagnosis.

Pullorum disease is usually fatal, and it is not uncommon to lose from 40 to 75 per cent of the chicks. Sometimes all the chicks in a brood die of this disease, making it almost impossible to rear chicks from infected flocks. Chicks that survive often remain stunted and unthrifty for a long time.

POST-MORTEM FINDINGS

Frequently, only a few changes are observed on post-mortem examination, the rapid and early development of the disease preventing the formation of any characteristic lesions. In those cases where the disease has lasted for some time the loss of flesh is very noticeable and the muscles of the wings and legs may be greatly wasted. Often, gray or yellowish necrotic areas or nodules are present in the lungs and heart muscles. Occasionally, such areas also occur in the liver, spleen, and gizzard. The intestines are frequently filled with a grayish or brownish pasty material, and the intestinal wall is thickened and necrotic. At times, the liver is swollen and reveals gray, pin-point spots. An unabsorbed yolk may be present but this is not diagnostic of pullorum disease.

DIAGNOSIS

The most certain method of diagnosing this disease is by a bacteriological examination. Such an examination may be had by sending a number of the affected chicks to a diagnostic laboratory. The causative organism may be isolated from the blood of the heart and usually is present in the spleen, liver, kidneys, or yolk of an infected chick.

Pullorum disease must be differentiated from certain non-infectious conditions, especially those caused by faulty incubation, brooding, or feeding, as these too may lead to bowel disturbances.

It must also be differentiated from certain infectious conditions, the most important of which are coccidiosis and aspergillosis. Coccidiosis develops slower and most often affects chicks from three to six weeks of age. The hemorrhagic and necrotic areas in the intestinal wall frequently are characteristic of this disease. The coccidia are readily seen on microscopic examination.

In brooder pneumonia (Aspergillosis), a characteristic grayish or greenish growth may be observed in the respiratory tract. Microscopical examination will reveal the presence of the fungus causing this growth.

Clinically, pullorum disease is characterized by its early appearance, the occurrence of deaths a few days after hatching, and the high mortality during the first two or three weeks.

TREATMENT AND CONTROL

The control of pullorum disease should consist of prevention rather than cure. The so-called "cures" have little or no value, as it is impossible to reach the organisms after they have been distributed through the various organs by way of the blood. Sulphocarbolates, bichloride of mercury, permanganate of potash, or hypochlorite solution in the drinking water have been recommended to inhibit the growth of *Salmonella pullorum* and lessen the attack of the disease in chicks. It is questionable whether medicated drinking water is a factor in the control or prevention of pullorum disease.

When the disease appears it is advisable to kill and burn all visibly sick chicks. The brooder house and other equipment should be frequently cleaned and disinfected. The housing and feeding of chicks is important. Chicks hatched from infected stock may show a low death rate when properly brooded and fed. Good care increases their resistance to disease.

Regular fumigation with formaldehyde, together with strict sanitation in the hatchery, will prevent the spread of this disease to a marked extent. The formaldehyde is liberated at various intervals during the period of incubation and while the chicks are hatching. Effective fumigation is dependent on a relatively high humidity being maintained in the incubator. However, fumigation does not destroy the infection in the body of the chick or inside the egg. Diseased chicks may infect healthy chicks by contact, and it is important to remove all weak chicks immediately from the brood, as they may be infected.

Brooding on wire or hardware cloth will remove the droppings from the pen at the time they are voided, and darkening the brooder for the first few days will keep the chicks quiet. Both of these procedures will limit the spread of the disease from the ingestion of infected droppings.

THE DISEASE IN ADULT FOWLS

Infected hens usually do not show symptoms of the disease, and it is not a common cause of death in mature fowls.

The disease is frequently introduced into a flock by the purchase of eggs for hatching or of baby chicks. The female chicks recovering from pullorum disease often become carriers, harboring the infective agent, mainly, in the ovary. The organism causes many of the ova to become abnormal and some to undergo degeneration. The ovary of the infected hen may continue to function, and occasionally an ovum is released which contains the organism. Cases have been reported where from 50 to 70 per cent of the hens in a flock were infected.

In hens the infection is generally localized in the ovary; while in cocks it may sometimes be present in the pericardial sac and very rarely in the testicles. It may be possible for the male birds to carry the infection from one hen to another, as hens have been infected experimentally by injecting the organism into the cloaca and oviduct. The disease seems to spread more rapidly among hens when males are present in a flock. Ovarian infection can also be produced by eating infected eggs. Adult hens may become infected by association with infected hens through contaminated litter. A hen with an infected ovary may continue to lay, but production is usually diminished.

SYMPTOMS AND LESIONS

In the chronic form no symptoms are observed and the lesions are mainly confined to the ovary. Generally, the ovary contains

several angular, hard, or discolored ova. The yolks may be of a greenish or dark brown color. Sometimes, only cysts are present, and occasionally yellowish colored bodies, either solid or containing a fluid, are pendent from the ovary or found free in the abdominal or thoracic cavities.

Adult fowls may develop a fatal septicemia due to *Salmonella pullorum* infection usually originating from a diseased ovary. In acute cases, the fowls show loss of appetite and appear listless, the comb and wattles are pale, sometimes cyanotic, and a diarrhea is often present. Deaths may occur within a few hours or a number of days after the onset of symptoms. Small necrotic foci may be observed in the liver, spleen, pancreas, and heart. A fibrinous exudate is frequently present on the liver, intestines, and pericardium.

DIAGNOSIS

Pullorum disease may be diagnosed in the adult, living bird by collecting blood and using the serum for the agglutination test. The finding of characteristic lesions in the ovary on post-mortem examination is diagnostic, and *Salmonella pullorum* may be isolated from the abnormal ova.

PREVENTION

Most outbreaks of pullorum disease in chicks can be traced directly to the presence of infected hens in flocks from which eggs for hatching were obtained. The means of prevention is by the elimination of infected breeding stock. Adult fowls that are carriers of the infection must not be used as breeders. All eggs for hatching should be obtained from flocks known to be free from the disease.

It is possible to lessen the ravages of this disease by proper incubation, care, and feeding. However, the care in housing and raising the chicks will not prevent heavy losses from this disease in all cases. The best way to attack pullorum disease is through the hens. Infected hens frequently are low in egg production or are non-producers and may be removed from the flock by trapnesting and culling. However, many of the hens that produce infected eggs can not be eliminated by these methods. Two other methods, the intradermal and agglutination tests, have been developed for detecting the infected hens and have been proposed as practical means for the eradication of this disease.

The intradermic or pullorin test is made by introducing into the wattle a product prepared from *Salmonella pullorum*. Observa-

tions are made from eighteen to twenty-four hours following the injection. A positive case is indicated by the appearance of a soft, edematous swelling at the point of injection. Care must be exercised in introducing the test fluid, and experience is necessary to interpret the results properly. It appears that the intradermal or pullorin test in its present state of development is not as satisfactory in detecting carriers of pullorum disease as is the agglutination test. At this time the pullorin test is not being used by the states officially engaged in eradicating the disease.

THE AGGLUTINATION TEST

The agglutination test is being used more extensively each year for diagnosing pullorum disease in mature fowls, and the results obtained by testing and removal of reactors justify confidence in the test when it is properly applied. It offers the most effective and practical means available at the present time for eradication and prevention of the disease.

The agglutination test consists in adding a small amount of blood serum from fowls to a dilute suspension of the organisms. If the fowls have the disease, the organisms will form clumps and settle to the bottom of the tube, and the fluid above will be clear. The blood serum from hens that are free from the disease will not cause the organisms to clump and the suspension will remain cloudy. The test should be made in a laboratory under the direction of a competent bacteriologist.

All the fowls in a flock should be tested, and those that react must be removed from the breeding pens and not allowed to associate with healthy hens. One test may not entirely eliminate the infection from a flock even if all reactors are removed. It is generally recognized that repeated tests may be necessary to detect all the infected fowls in a breeding flock. Apparently, the blood of some fowls that harbor *Salmonella pullorum* is subject to rapid changes which frequently cause discrepancies in the agglutination test. Fowls that are negative to repeated tests may later become positive if exposed to the infection in adult life.

One test during a season on an infected flock is not considered to be a reliable procedure for establishing pullorum disease-free flocks. It is recommended that a diseased flock be retested several times a season, or that the entire flock be disposed of and replacements obtained from known disease-free sources. Retests of infected flocks are to be made each month or six weeks until no

reactors are found. This method of testing is considered to be a more economical and successful means of eradicating this disease than a single annual test.

The unsuccessful attempts to eradicate pullorum disease from some flocks are often attributed to inaccuracies of the agglutination test. Failures are to be expected if only a portion of the flock is tested. All reactors must be removed immediately from the premises and not be retained for egg production purposes. The eggs from a disease-free flock should never be placed in incubators with eggs from untested flocks. Eggs, chicks, and mature stock should be purchased only from known disease-free flocks. Dispose of all infertile and dead-germ eggs and offal from reactors, so that they cannot infect healthy fowls. Thoroughly clean and disinfect the houses immediately after the reacting birds have been removed. If pullorum disease is to be eradicated from a flock by use of the agglutination test, it is of utmost importance to observe these precautions. The greatest progress toward the eradication of this disease can be made by establishing pullorum disease-free flocks for the purpose of supplying eggs for hatching, chicks, and breeding stock.

A SYSTEM OF PROCESSING ROUGHAGES FOR DAIRY COWS

C. F. MONROE AND C. C. HAYDEN

PART I.—COMPARISON OF ROUGHAGES PROCESSED WITH AND WITHOUT CONVERTER MATERIAL

From time to time methods have been devised and promoted for converting dry roughage into succulent feed. All these methods are quite similar; in general, they consist in treating ground or chopped roughage with warm water and "converting" materials. The warm, wet mixture is then allowed to stand several hours in insulated tanks before feeding. The roughage thus prepared is claimed to have a great advantage over the normal dry roughage ration of whole stover, hay, and corn silage, for, not only is this roughage fed warm, wet, and soft, but it is supposed to contain an additional element of advantage due to the action of the converter added.

While it would seem that the expense of processing would render these methods impractical, it is a fact that quite a few dairymen have been attracted by the claims made for such systems. Previous experiments[1] have shown that with two such systems, at least, there was little or nothing to be gained.

A processing system of recent development, and one for which good results have been claimed, was the subject of the investigation reported here. This system is known as the "Kultogras" method of feeding. The converter used in this method is called Kultogras, and is claimed to be a culture which produces a desirable chemical change in the feeds to which it is added.

The primary object of this work was to determine whether feeds processed with this new converter would cause the cows to produce any more milk than the same feeds processed with a mixture of ground corn and oats, substituted for the converter. The corn and oats were used to make the two mixtures equal in food nutrients, and hence the sole difference between these two rations would lie in the specific effect of the converter. A secondary object was to compare these two processed rations with an equivalent ration not processed but containing dry roughage and corn silage.

[1]Bulletin 92, Central Experimental Farm, Canada. Special Circular 29, Ohio Agricultural Experiment Station. Bulletin 405, Wisconsin Agricultural Experiment Station. Research Bulletin 102, Wisconsin Agricultural Experiment Station.

This experiment was conducted with the cooperation of the State Department of Public Welfare, and a portion of the dairy herd at the State Institution for Feeble Minded located at Orient, Ohio, was used. A representative from the Dairy Department of the Experiment Station personally directed the work, attending to weighing and mixing feeds and recording results. Two groups of 16 Holstein cows each were selected from the herd for the experiment. These cows were all in an early stage of lactation. They were fed and milked three times a day.

The entire experiment, which lasted 200 days, was divided into 4 periods, as follows:

Period A, 30 days, during which both groups were fed a normal ration containing silage.
Period B, 70 days, during which both groups were fed the processed roughage, without silage.
Group I received the roughage processed with the converter.
Group II received the roughage processed with the corn-and-oats mixture.
Period C was the same as Period B except that the rations fed Groups I and II were reversed.
Period D, 30 days, during which both groups received the normal ration, as in Period A.

This scheme of arrangement is shown in Table 1.

TABLE 1.—Showing Experimental Divisions

Period	A 30 days	B 70 days	C 70 days	D 30 days
Group 1 16 cows............	Normal ration	Converter ration	Check ration	Normal ration
Group 2 16 cows............	Normal ration	Check ration	Converter ration	Normal ration

METHOD OF PROCESSING

The method used to process the roughage was that recommended by the manufacturers of the converter. The roughage mixture, composed of 60 parts of chopped alfalfa and 40 parts of chopped corn fodder, was put into an insulated tank. As the above mixture was being placed in the tank, salt, converter, and water at 140° F. were added and distributed as evenly as possible. In another tank the check processed mixture was made in a similar manner except that the mixture of corn and oats was substituted for the converter. The formulas for these two mixtures are as follows:

CONVERTER MIXTURE

	Pounds
Chopped alfalfa	60
Chopped corn stover	40
Salt	1
Converter	3
Water, 140° F.	300

CHECK MIXTURE

	Pounds
Chopped alfalfa	60
Chopped corn stover	40
Salt	1
Corn and oats	3
Water, 140° F.	300

A sufficient quantity was prepared in each tank to feed 16 cows for one day.

FEEDING

These processed mixtures took the place of corn silage and most of the dry hay in the normal ration. They were fed at the rate of 7 pounds of the wet materials for every 100 pounds of live weight. Grain was fed at the rate of 3 pounds for every 10 pounds of milk produced. As this level of feeding did not seem to satisfy the cows, some additional chopped alfalfa hay was fed. As the stalls were equipped with drinking cups, the cows had free access to water. For a few hours each day (the time depending upon the weather) the cows were allowed the freedom of a paved barn lot, where they had access to salt and water.

TABLE 2.—Summary of Results (Averages of 32 Cows for 60-day Periods) on Each Ration

	Milk produced	Fat	Fat	4 per cent milk equivalent	Milk per 100 lb. dry matter	Gain per 100 lb. live weight	Refuse	Cost of converter
	Lb.	%	*Lb.*	*Lb.*	*Lb.*	*Lb.*	%	*Dol.*
On converter ration (Kultogras)	2033.2	3.38	68.8	1845.5	86.9	48.21	1.0	4.59
On check ration (Corn and oats)	2047.1	3.35	68.5	1845.7	87.3	14.98	1.2	.63
Difference*	−13.9	+.03	+.3	− .2	−.4	+33.23	− .2	−3.96

*—favors the check ration; +favors the Kultogras ration.

Table 2 gives the results obtained from feeding the two processed mixtures. These figures are for periods of 60 days on each ration, the data for the first 10 days having been eliminated to allow for the effects of the change in the ration. The data represent the averages for the 32 cows.

With respect to milk and butterfat production, there was as little difference between the two rations as could have been expected if the same ration had been fed to both lots throughout. With respect to the amount of processed feed refused, there was also very little difference, indicating that the check mixture was about as palatable to the cows as the converter mixture.

The live weight data offer some indication that the converter mixture tended toward a greater increase in body weight, the difference averaging 33 pounds per 1000 pounds of live weight during the 60-day periods. Just how much emphasis should be placed on this difference is a question, inasmuch as the cows kept in good condition on both feeds.

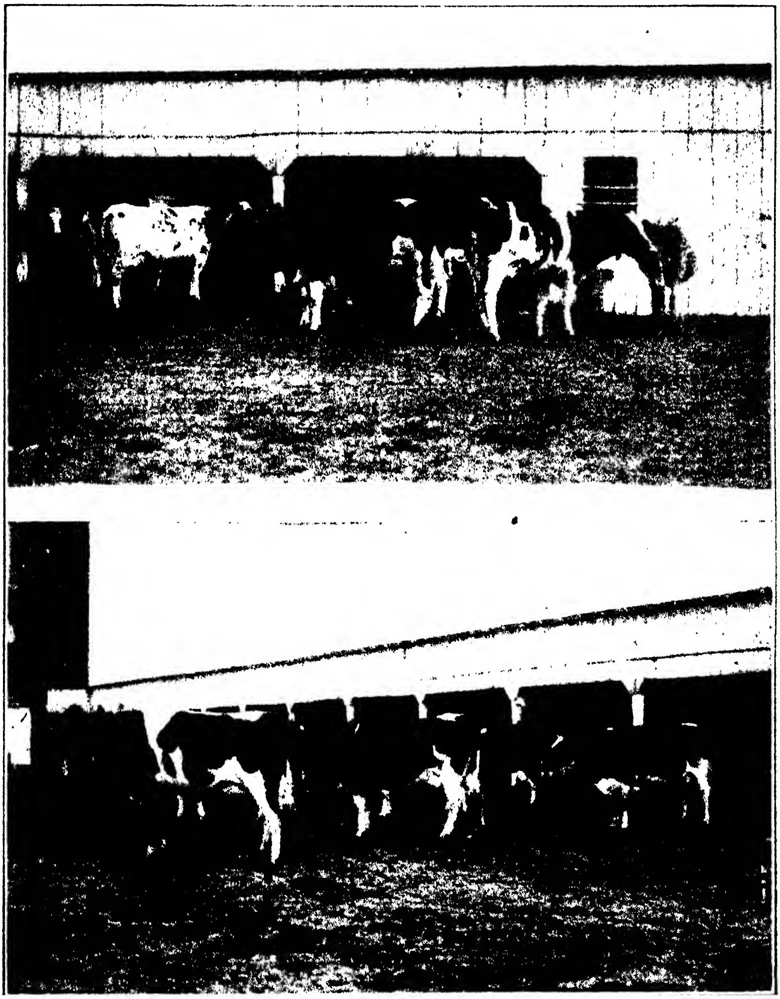


Fig. 1.—(A) Group I. Representatives from the group on the check ration, at the close of the experiment

(B) Group II. Representatives from group on converter ration, Kultogras, at the close of the experiment

Toward the close of this experiment a group of experienced dairymen, who were looking at the cows, were asked to pick the

group which they considered in the better condition. Of the five dairymen, three selected the group receiving the check mixture, while two picked the converter group; but all felt that there was very little difference between the two groups. The bowels of all the cows were apparently well regulated and the feces had much the same consistency as when on pasture.

The most important difference was in the cost of the two rations. It cost $3.96 more per cow to feed the converter mixture for 60 days than it did the check mixture[2].

CHEMICAL CHANGES

In laboratory tests the converter was found to have diastatic power, or power to convert starches into invert sugars. However, when alfalfa hay and corn stover were processed with it there was little sugar produced. This was because the roughages did not furnish any starch and the little sugar that was formed came from the starch in the converter. Laboratory trials also failed to show that the liquid extracted from the converter-processed material was any richer in protein, ash, or total solids than the liquid from the check-processed material.

SUMMARY

Processed roughages produced by using converter called Kultogras have been compared to like roughages processed with a mixture of corn and oats. Production of both milk and butterfat was practically the same on both types of processed roughage. There was a greater tendency to gain in liveweight when the converter processed roughage was fed. If there was any difference in palatability of the two roughages it was slight; on the converter roughage there was a refuse of 1 per cent, while on the check roughage there was a refuse of 1.2 per cent.

PART II.—PROCESSED ROUGHAGE FEEDING COMPARED WITH NORMAL FEEDING

As shown in Table 1, Part I, the processed feeding periods were preceded and followed by a 30-day control period, in which the cows were fed roughage in the ordinary or "normal" manner. They were allowed all the alfalfa hay they would eat and were fed corn silage at the rate of 3 pounds to every 100 pounds of live weight.

[2]Kultogras @ $13. per cwt. Ground corn and oats @ $1.50 per cwt.

The same grain mixture was fed at the same rate as during the processing periods. In fact, on the basis of total nutrients supplied, the two systems of feeding were almost identical. The difference between the two was that in the processing system most of the roughage was fed in a warm, wet, and softened condition after it had been chopped; while the roughage in the normal system was fed as ordinary whole hay and corn silage, the latter substance replacing the chopped corn stover in the processing system.

For this comparison, the data from only 20 of the original cows have been used. Data from the other 12 cows have been eliminated for the following reasons: segregation following a positive reaction to the blood-test for abortion (6 cows); abortion (1); starting to dry up (1); freshening a few days after the experiment started (2); and, finally, 2 from one group to equalize the numbers in the two groups. The 20 cows remaining had a clear history for the entire 200 days of the experiment.

TABLE 3.—Comparison of Normal System of Feeding to Processed System (without converter)
Av. per cow—40-day periods

	Milk	Test	B. F.	4 per cent milk	Liveweight
	Lb.	*Pct.*	*Lb.*	*Lb.*	*Lb.*
‡Normal	1341.52	3.60	48.24	1260.30	1158.1
§Processed (no converter)	1349.55	3.30	44.57	1208.55	1164.5
†Difference	+8.03	—.30	—3.67	—61.75	+6.4
*Per cent difference	+0.598	....	—7.60	—4.89	....

*Normal=100%.
†Normal=standard.
‡Normal=Group II, Period D and Group II, Period A.
§Processed=Group I, Period C and Group II, Period B.

TABLE 4.—Comparison of Normal System of Feeding to Processed System (Converter used)
Av. per cow—40-day periods

	Milk	Test	B. F.	4 per cent milk	Liveweight
	Lb.	*Pct.*	*Lb.*	*Lb.*	*Lb.*
‡Normal	1382.10	3.71	51.27	1322.05	1149.4
§Processed	1357.49	3.36	45.65	1227.71	1154.7
†Difference	—24.61	—.35	—5.62	—94.34	+5.3
*Per cent difference	—1.78	....	—10.96	—7.13	....

*Normal=100%.
†Normal=standard.
‡Normal=Group I, Period A and Group II, Period D.
§Processed=Group I, Period B and Group II, Period C.

The method used in comparing the results under the different systems of feeding was essentially that used for the double reversal experiment; that is, the productions for the two groups for different periods on the same type of ration have been combined. The method of combining, as well as the results, is shown in Tables 3 and 4, the former table for nonconverter processed roughage and the latter for the converter processed, with their respective normal feeding periods.

As the first 10 days of each period have been considered preliminary, they have not been included in the results. On this basis, there were 20 days in each control period and 60 days in each processing period. In order to place the productions on a comparable basis, the 60-day processing periods have been divided by 3, giving for these periods an average 20-day production. For each of the 20 cows there were two control periods and two processed feeding periods.

RESULTS

The production of the two groups as given in Tables 3 and 4 represents the averages per cow for 40 days on each type of feeding. The rate of production for the entire experiment averaged a little over 1000 pounds of milk and 36 pounds of fat per 30-day month.

These comparisons show that there was little difference between the two systems of processing, as measured by a common standard. This is similar to the finding when the two processed systems were compared directly with each other, as shown in Part I. Hence, in the discussion to follow a distinction is not made between the two types of processing.

The production of milk was nearly the same on the normal feeding as on the processed feeding. However, the butterfat production was from 7.5 to 11 per cent higher on the normal feeding than on the processed feeding. The average difference in butterfat test amounted to approximately .32 per cent. Butterfat tests for the individual cows (not given in table) show that this tendency was quite uniform; for, of the 40 individual comparisons here represented, 34 showed a higher average test in the normal feeding periods than they did in the respective processed feeding periods.

The liveweights under the two systems of feeding indicate a slight advantage for the processing system. The extent of fill may have played quite an important part in the liveweights. The processed rations, owing to their water content, weighed considerably more than did the normal rations. As the cows were weighed in

the morning soon after feeding, it is possible that these heavier rations would affect the liveweights. However, under neither system of feeding were the cows out of condition or noticeably thin.

SUMMARY

The normal system of feeding, which included ordinary alfalfa hay and corn silage, has been compared with two systems of feeding processed roughages. These processing systems differed only in respect to the converter material used, one containing a converter called Kultogras and the other a like amount of a mixture of corn and oats. In comparing the milk and butterfat produced under these two systems to a common, or normal, system, it was found that there was practically no difference in the two processed rations. This finding agrees with that of the direct comparison of these systems with each other, as described in Part I.

The average production of milk was approximately the same on the normal and processed systems. Butterfat production was from 7.5 per cent to 11 per cent higher under the normal system of feeding. These results indicate that insofar as milk and butterfat production were concerned, nothing was gained by processing the roughage.

GREENING SEED POTATOES BEFORE PLANTING

JOHN BUSHNELL

Spreading seed potatoes in the light to green for two weeks or more before planting is a common practice in northeastern Ohio, especially when planting is delayed until June. Potatoes do not keep well in an ordinary storage this late in the season, and greened seed is superior to seed which has sprouted and wilted in the dark. The process is variously called "sun-sprouting", "light-sprouting", or "green-sprouting", but the shorter term "greening" will be used here.

The advantages of greening are so well-known that they need only be briefly enumerated: (1) The process is a good "germination" test, for any tubers that have weak sprouts at the time of cutting are conspicuous and easily sorted out. (2) The short, tough, green sprouts adhere during cutting and planting, and appear above ground shortly after planting. (3) Under some circumstances this rapid development results in better stands, par-

ticularly on heavy soils. In view of these advantages the question naturally arises whether it would not be profitable to green all seed potatoes irrespective of the date of planting.

In many parts of northeastern Europe greening is a standard farm practice. Large greenhouses are built especially for storage of seed, and the potatoes are greened all winter. After such treatment the sprouts make rapid growth, giving better stands and earlier crops than dormant seed from dark storage. Northeastern Europe has a maritime climate, hence the soil is slow to warm in the spring, and growth of dormant seed is slow.

Fig. 1.—Long sprouts from dark storage compared with the short, green type resulting from exposure to light.

In North America, on the other hand, the change from winter to summer is so rapid that dormant seed, planted early, sprouts quickly. Most experiments with greening prior to early planting, in the United States, have not shown any benefits from the treatment. There have even been some reports of reduced yields. Consequently greening is not advocated nor practiced for early potatoes in North America.

To determine the extent to which greening of the main crop, Russet Rural, might prove profitable in Ohio, experiments have been carried on for a number of years. At the outset, it was noted that for late, June planting greened seed was decidedly superior to seed which had sprouted excessively in storage. In one experiment, for example, greened seed yielded at the rate of 204 bushels per acre, and desprouted seed from a dark storage 167 bushels. But it was also found that planting in late June was not to be ordinarily advocated, because larger yields were obtained from planting in May.

The experimental yields from greening Russet Rurals for ordinary planting dates at Wooster are given in Table 1. The

ungreened seed in these tests was in good condition, either dormant or with small sprouts. In only two seasons out of six did the greened seed outyield that directly from good storage, and the average was in favor of the ungreened seed.

There are special instances, however, when late planting is advisable. The best recommendation at present for the production of seed potatoes is to delay planting until late June. There are occasional seasons when frequent rains delay planting. In all such instances the seed should be removed from storage before long sprouts develop, and spread in the light to green.

Methods of greening.—Experiments have been conducted to determine the best conditions for greening. As intimated above, the common practice in Ohio is to keep seed potatoes in dark storage as long as feasible, usually until sometime in May, and then to expose them to light for from 2 to 6 weeks.

To determine the effect of length of exposure, samples were taken from storage at intervals of 4 weeks, beginning in March, and spread in a greenhouse. These, planted June 28, gave yields as shown in Table 1. Prolonged greening was detrimental.

TABLE 1.—Effect of Length of Greening in a Warm Greenhouse on the Value of Seed Potatoes

Greened for	Yield Bu. per acre
4 weeks	169
8 weeks	161
12 weeks	138
16 weeks	121

This, it may be noted, is contrary to the European custom of greening throughout the winter. The difference is probably due to the fact that in the warm greenhouse at Wooster considerable shrivelling resulted from long exposure, whereas in Europe the greenhouses are kept cooler and humid to prevent shrivelling.

Further evidence that the shrivelling is a disadvantage was obtained from a comparison of seed greened under three distinct conditions. Samples were exposed in a greenhouse, in a cold frame, and under artificial light in a cool storage. The yields in bushels per acre were as follows:

Place exposed:	Yield in bushels:
Outside, in cold frame	204
Cool room, with artificial light	190
In warm greenhouse	189

The cold frame was damp at the outset and was left open except on cool nights. The tubers were thus exposed to the rain and to the water that condensed on the sash and dripped off. They were noticeably firmer than the potatoes from the other treatments and, when planted, gave the highest yield.

RECOMMENDATIONS

If seed potatoes are exposed to light for a week or more before planting they develop short, tough, green sprouts that adhere during planting and emerge from the soil sooner than sprouts from dormant seed. The earlier emergence is usually not of sufficient advantage to justify the practice for early planting or even for May planting.

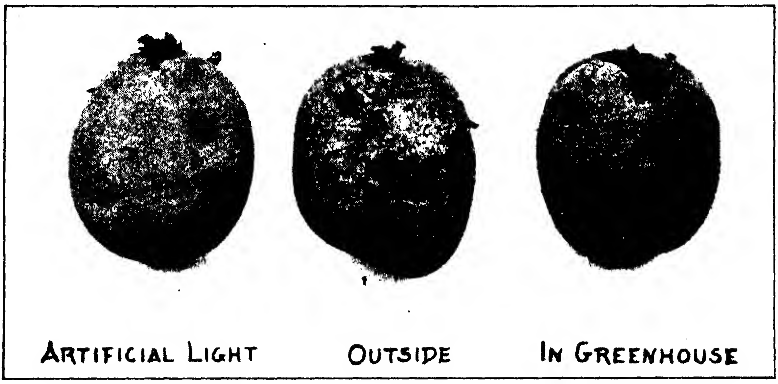


Fig. 2.—The green sprouts are essentially alike irrespective of the conditions of exposure
The center tuber was discolored by the rain

If, however, it is impossible to maintain a potato storage cool enough to retard sprouting, it is better to remove the seed from storage and green it than to allow long sprouts to develop in ordinary storage. Greening is thus a means of keeping seed potatoes in good condition for late planting.

Wilting or shrivelling of the tubers during greening is to be avoided. Exposure outside, where the potatoes were wetted by the rain, proved to be better than exposure in a greenhouse where the tubers wilted perceptibly.

No special equipment is necessary. The potatoes may be spread in any barn or shed, where they can be sprinkled lightly, or outside. It is only necessary to spread them thinly so that light reaches each tuber, to cover them at any time there is danger of frost, and to avoid having them in standing water.

1929 PAPER MULCH RESULTS AT MARIETTA

ROY MAGRUDER

Light-weight, Gator Hide mulch paper was used in all the tests. The 36-inch width was used for cabbage, sweet corn, tomatoes, and peppers in the recommended manner for the cultivated aisle system of culture; i. e., two rows of plants being planted on each strip with the hills or plants staggered in arrangement. The rows were approximately 20 inches apart. Hills of sweet corn (2 plants) and plants of tomatoes and peppers were set 2 feet apart in the rows, with cabbage spaced 14 inches apart. Three-foot aisles were left between these strips of paper for all except cucumbers, where the aisles were 5 feet. Two rows of cucumbers were planted, one in the middle of a 3-foot strip and the other in the middle of an 18-inch strip. The hills were spaced 2 feet apart and the plants thinned to two in each hill.

Fig. 1.—View of paper-mulched garden at Marietta, 1929. Cultivated, on left. Mulched section, on right. Note planting arrangement of peppers and larger size of sweet corn and peppers.

The same planting arrangement was followed in both the cultivated and paper-mulched sections, the paper-mulched section being along one end of the field and the cultivated section along the other end.

Because of the narrowness of the double rows, the space between them was hand hoed. The aisles of both sections were cultivated with a one-horse hoe cultivator and weeds along the edges of the strips were cut with hand hoes.

April, May, and June had a higher rainfall than normal and there was no water shortage during this period. July and August, however, were dry months, the rainfall being considerably below normal for July. April and May were also cooler than normal.

Cabbage.—Four rows (two strips of paper) of Stokes strain of Viking Copenhagen Market cabbage were planted in this test. The plants were set April 19 and the first harvest made on June 18. As shown in Table 1, the paper-mulched area on the first harvest produced 3.8 times as many marketable heads, 4.4 times as many pounds, and the heads averaged 14 per cent larger, than the cultivated section. The later maturing heads on the cultivated section were larger than those from the paper-mulched section and the average weight per head for the entire crop was about 14 per cent larger from the cultivated section.

TABLE 1.—Effect of Paper Mulch on Earliness and Yield of Early Cabbage—Marietta, 1929

Treatment	First harvest				Total		
	No. heads	Total wt.	Av. wt.	Per cent of total heads	No. heads	Wt.	Av. wt.
		Lb.	*Lb.*			*Lb.*	*Lb.*
Paper-mulched	73	172	2.35	17.5	417	1254	3.01
Cultivated	19	39	2.05	4.5	416	1427	3.43

Sweet corn.—One strip (2 rows) of Vanguard (white) and one strip of Rice's strain of Whipple's New Yellow were planted April 19 and later thinned to 3 stalks per hill. Only two harvests of marketable ears were made, the first on July 25 and the last on August 1.

The first plants appeared in the paper-mulched plot about 3 days sooner than in the cultivated section and were larger throughout the growth period. The Vanguard plants on June 6 were 3.7 inches, on June 20 were 4.4 inches, and on July 3 were 6.9 inches taller on the paper-mulched than on the cultivated section. The differences in the Whipple's New Yellow variety in favor of the mulched plot on these dates were, respectively, 2.0 inches, 3.1 inches, and 4.6 inches.

TABLE 2.—Effect of Paper Mulch on Earliness and Yield of Early Sweet Corn—Marietta, 1929

	Paper-mulched	Cultivated
Vanguard		
Total number plants	343	359
First harvest, No. of ears	150	94
First harvest, Av. wt. of ear (lb.)	.81	.81
First harvest, Per cent of total No. ears	51	42
Total harvest, No. of ears	295	225
Total harvest, Av. wt. of ear (lb.)	.74	.72
Whipple's New Yellow		
Total number plants	310	280
First harvest, No. of ears	28	20
First harvest, Av. wt. of ears (lb.)	.70	.63
First harvest, Per cent of total No. ears	19	9
Total harvest, No. of ears	150	210
Total harvest, Av. wt. of ears (lb.)	.79	.76

The figures in Table 2 would seem to indicate that the paper mulch hastened the maturity of both varieties but had very little effect on average size of ear. It increased the number of ears per hill in the Vanguard variety but had the reverse effect in the Whipple's New Yellow variety.

Cucumbers.—Seed of Livingston's strain of Early Fortune cucumber was sown May 1 and later thinned to two plants in each hill. One row was planted in the middle of an 18-inch strip and a second row on a 36-inch strip.

The first harvest was made July 12 and the last on August 10, with pickings at 3- to 4-day intervals during this period. The fruit was graded into fancy and choice according to the regulations of the Marietta Truck Growers' Association after the first four harvests.

TABLE 3.—Effect of 18- and 36-inch Width Paper Mulch on Earliness and Yield of Early Cucumbers—Marietta, 1929

	18-in. width		36-in. width	
	Paper-mulched	Cultivated	Paper-mulched	Cultivated
Total No. hills	65	70	68	69
No. fruit first harvest	70	20	75	20
Av. wt. fruit first harvest (lb.)	.80	.75	.88	.80
No. fruit, first three harvests	180	149	216	140
Av. wt. fruit, first three harvests (lb.)	.82	.77	.84	.76
July 22–Aug. 10				
No. fancy fruit	194	251	286	322
Wt. fancy fruit (lb.)	148.0	210.5	238.5	277.0
Av. wt. fancy fruit (lb.)	.76	.83	.83	.86
Per cent fancy fruit	53	69	66	80
Total No. marketable fruit	542	513	648	538
Total wt. marketable fruit (lb.)	396.0	389.5	513.0	434.5
Total av. wt. marketable fruit (lb.)	.73	.75	.79	.80

The seedlings emerged from the soil two to three days earlier in the paper-mulched section than in the cultivated, and as shown in Table 3, produced 3½ times as many fruit at the first picking as the cultivated section. The average size of fruit was also larger from the paper-mulched section. When the latter part of the harvesting season is considered it is seen that the cultivated section produced a larger number and larger percentage of larger fruit than the paper-mulched. The data for the entire season's marketable fruit show very little difference in number, size, or production between the 18-inch paper-mulched section and the cultivated section. There was a marked difference in favor of paper mulch between the results from the 36-inch paper-mulched row and its corresponding cultivated section.

Under these conditions the 36-inch strip of paper produced better results than the 18-inch strip.

Tomatoes.—Seed of Stokes' strain of Bonny Best and Murry's Early Wonder tomatoes were sown in the greenhouse March 18 and the transplanted plants set in the garden on May 17. Each plant was pruned to a single stem and tied to a stake. Harvests were made at 1- to 3-day intervals and the fruit sorted into fancy and choice grades.

TABLE 4.—Effect of Paper Mulch on Earliness and Yield of Early Tomatoes—Marietta, 1929

	Bonny Best		Early Wonder	
	Paper-mulched	Cultivated	Paper-mulched	Cultivated
Total No. of plants	139	143	140	141
Pounds fruit first 3 harvests	13	24	13	21
Total marketable fruit (fancy and choice) lb.	504	584	421	458
Per cent of fancy fruit	69	69	53	51

The paper-mulched plants made the largest growth but did not mature their fruit as rapidly as the cultivated plants. There was practically no difference in total yield or percentage of fancy fruit between the two treatments in either of the varieties.

Bonny Best yielded approximately 20 per cent more and was as early as Early Wonder.

Peppers.—Two rows of transplanted plants from Harris' strain of Early Giant and two from Stokes' strain of the same variety were set in the garden on May 18. The seed had been sown in hotbeds February 16 and the plants transplanted on April 2.

Mature green fruit was harvested at approximately weekly intervals from July 2 until September 12.

The use of paper mulch increased slightly the number and size of fruit harvested during the early part of the season. This effect was more pronounced on Stokes' strain, which had larger plants with later maturing fruit. The differences in total yield are hardly significant.

TABLE 5.—Effect of Paper Mulch on Earliness and Yield of Early Sweet Peppers—Marietta, 1929

	Harris' Strain		Stokes' Strain	
	Paper-mulched	Cultivated	Paper-mulched	Cultivated
Total No. plants	136	140	140	142
First harvest, No. fruit	142	106	49	32
First harvest, Av. wt. per fruit (lb.)	.12	.11	.16	.15
Second harvest, No. fruit	106	132	116	68
Second harvest, Av. wt. per fruit (lb.)	.14	.14	.16	.14
Third harvest, No. fruit	167	160	230	176
Third harvest, Av. wt. per fruit (lb.)	.13	.13	.13	.14
Total harvest, No. fruit	2136	2294	2019	2460
Total harvest, Av. wt. per fruit (lb.)	.13	.15	.15	.14

Potatoes.—One row of 129 hills of Irish Cobbler potatoes was planted through an 18-inch strip of paper on March 28. The hills were one foot apart. The plants emerged from the soil about 3 days earlier than those in the cultivated rows on each side but there was no difference in time of maturity between the two treatments.

They were harvested July 16 and the yield data show no appreciable increase in marketable tubers from the use of paper as a soil mulch. The increase in small tubers was about 30 bushels per acre. In other words, there was a greater set under the paper, but the larger numbers of tubers failed to reach marketable size. In view of the high cost of the paper there is no reason to expect that paper mulch will prove profitable on the potato crop.

Summary.—Paper mulch increased the early yield of cabbage, cucumbers, peppers, and sweet corn and decreased the early yield of tomatoes. The results would not justify its use except on cucumbers and cabbage.

A SERIOUS ELM DISEASE IN OHIO

CURTIS MAY AND O. N. LIMING*

The Dutch elm disease, characterized by the sudden wilting of all or part of a tree, was found in two localities in Ohio early in the summer of 1930. This disease, described from Holland a little more than 10 years ago, has spread rapidly through northwestern Europe killing thousands of elms. The destructiveness of the disease there on street and park trees can scarcely be over-emphasized according to the reports appearing in various European publications. Some idea of the rapidity of the spread of the disease may be gained from a recent English report stating that there was one tree known to have the disease in England in 1927, 600 in 1928, and about 1200 in 1929. Stadtgartenmeister Garbers reports that some 2000 elms in Bremen have been cut down because of the disease. With these and other alarming reports before us the discovery of the disease in the State is a cause for great concern among those who appreciate the esthetic and practical value of the elm.

SYMPTOMS OF THE DISEASE

The sudden wilting of the leaves and tips of the new growth is the most striking symptom of the disease (Fig. 1). The leaves, in acute cases, wilt suddenly and become crisp but remain green and cling to the twig for some time. The tip leaves, after turning brown, frequently hang on the dead twig so that the disease may often be recognized in winter by the characteristically curled twig tips with a tuft of dead, brown leaves. In less acute cases the leaves may come out thin and small with a subsequent extended period of defoliation preceded by more or less yellowing of the

Fig. 1.—American elm with Dutch elm disease. Note wilting of leaves on tips of small twigs

*In cooperation with the Office of Forest Pathology, U. S. D. A.

individual leaves. Diseased trees frequently sucker abundantly and prematurely along the trunk. However, other diseases may cause suckering, and so this symptom is not confined to trees having the Dutch elm disease. The Dutch elm disease is essentially a wilt disease and the affected tree presents the appearance of a plant in need of water.

A brownish discoloration of the sapwood is evident when the bark is peeled from a diseased twig (Fig. 2). The stains in the wood generally appear as a number of short, disconnected, brownish streaks which cannot be followed for long distances in the twigs. Sometimes the infection is so heavy that the brownish discoloration under the bark extends completely around the twig. In cross section such heavy infections appear as a complete darkened ring in the sap wood. Generally, however, when an infected branch or twig is cut across, the discoloration of the sapwood shows as a more or less broken circle of brown spots; all woody parts of the tree may show these symptoms. A microscopic examination of the discolored wood shows that the water conducting tubes may have either numerous bladder-like outgrowths (tyloses) in them or may be filled with a brownish, gum-like substance. The cell walls in the discolored area are stained brown.

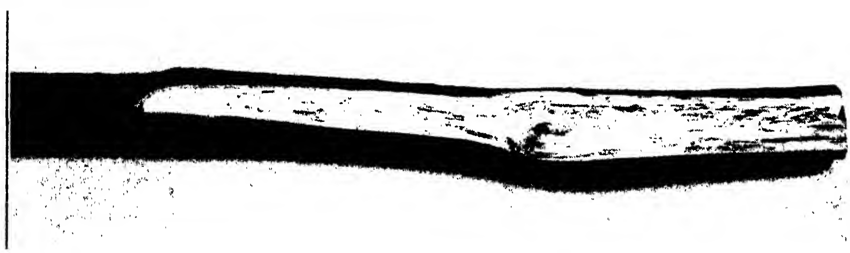


Fig. 2.—Small branch of elm with bark and part of sapwood cut away showing short, discolored streaks in wood caused by *Graphium ulmi*

Unfortunately, we have not yet found any diagnostic characteristic that is sufficiently different and constant to distinguish this disease in the field from Verticillium wilt. The latter disease appears to be widespread and serious in dry years at least. Wilting accompanied by defoliation and a brownish discoloration of the sapwood very similar to that found in cases of the Dutch elm disease make cultural methods the most reliable way to differentiate between the two diseases at present. Further field experience will probably show quicker means of identifying them.

NECESSITY FOR PROPER DIAGNOSIS

Reports have reached the Station regarding alleged cases of the Dutch elm disease which have been identified without sufficient information or investigation. The disease is very likely newly introduced into this country. The course of the disease in Europe warns us to deal respectfully with it here; consequently, misinformation regarding its distribution, spread, and eradication may lead to a serious situation. Last summer only a few diseased trees were found, making eradication appear feasible. If unfounded reports of the wide distribution of the disease should appear, eradication would seem unjustified. In the meantime, what might have been a relatively easy task, neglected because of a false impression of magnitude, later could become impossible. For the present, we urge that caution be exercised in the diagnosis of the disease.

CAUSE OF THE DISEASE

A fungus, *Graphium ulmi* Schwarz, is the cause of the disease. Its hyphae can be found sparingly in the water-conducting vessels of diseased trees. Pieces of infected twigs laid on moist earth soon become covered with the cottony mycelial threads of the parasite. The fungus is indeed versatile in the matter of spore production. Upright black stalks (coremia) composed of numerous, tightly compacted, parallel threads of mycelium surmounted by a glistening globe of spores may grow from such twigs (Fig. 3, No. 1). When the fungus is isolated on artificial media coremia may form on the bits of infected material used for the isolation, or on the media itself. The coremia do not develop in all cultures, or they may appear, particularly in old cultures, as long, black, tufted stalks lacking the ball of spores on top. A second type of spore is developed in small heads (Cephalosporium-like) all over the surface of the colony (Fig. 3, No. 3). The size of these spores varies considerably, some as large as 4.0 x 7.0 microns having been found. The average size of this type of spore is, however, about 2.0 x 4.0 microns. Coremia spores are more uniform, averaging about 1.7 x 3.2 microns. Yeast-like budding is also common.

Graphium ulmi is easily isolated from trees having the Dutch elm disease and will produce the typical symptoms of the disease, as has been repeatedly demonstrated, when healthy young trees are inoculated with it.

The fungus generally grows in culture as a white to dirty gray, slimy, appressed colony distinctly concentrically zonate (Fig. 3,

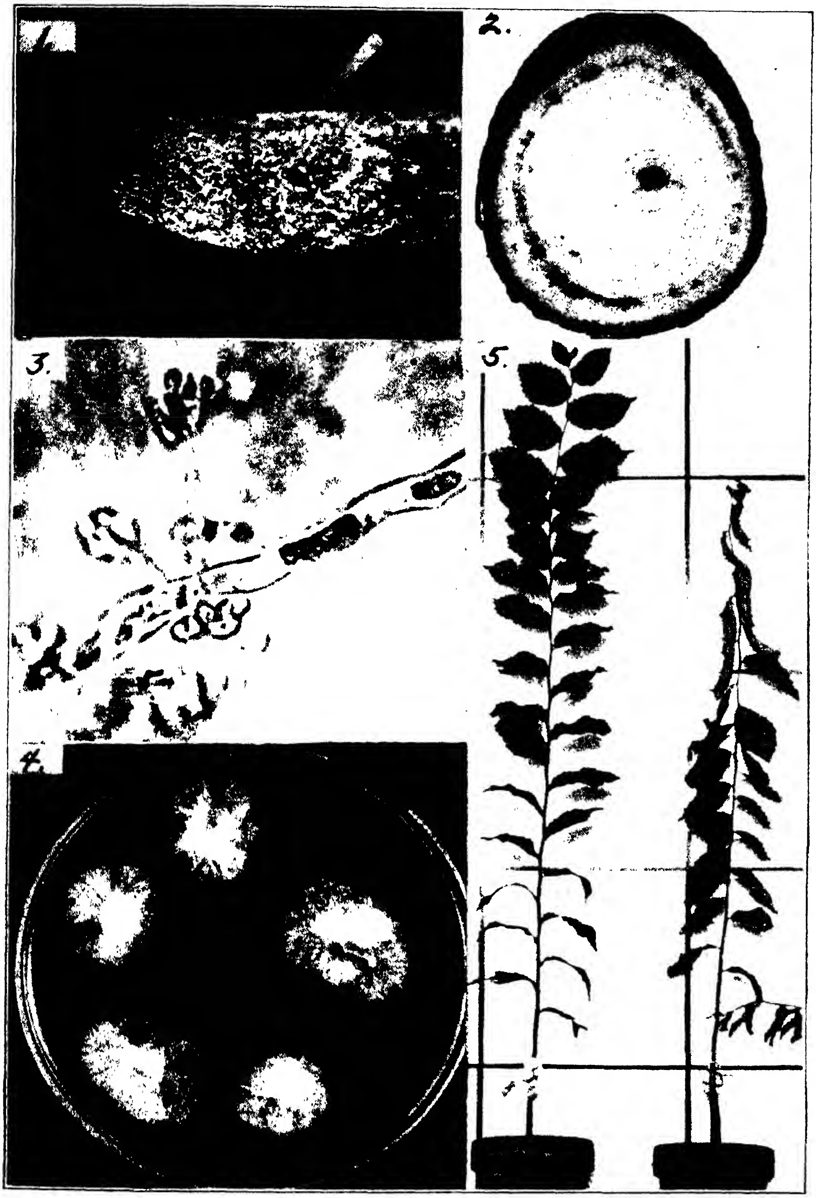


Fig. 3.—(1) *Graphium ulmi* Schwarz growing on end of infected elm twig on moist earth. Note coremia. (2) Cross section of infected branch showing discoloration of sapwood. (3) Mycelium of *G. ulmi* producing spores, X 2000. (4) Culture of *G. ulmi* 4 days old. (5) Right, American elm seedling 14 days after inoculation with *G. ulmi*. Note wilting and drooping of leaves. Left, uninoculated check tree.

No. 4). It may, on the other hand, produce a moderate amount of aerial mycelium with but little zonation, particularly after it has been in culture for some time.

PATHOLOGY

The disease does not affect all trees in the same degree. Some trees may be killed outright, others may show wilting of a few branches only, and still others may be infected without showing any external symptoms. This latter group is distressing because such diseased trees may serve as a source of further infections without themselves being detected. Reports from England indicate that some trees may apparently recover from the disease. Some trees known to have the disease in 1928 were free from external symptoms in 1929 and 1930. Other trees showing some killing of the tops in 1928 and exhibiting no signs of the disease in 1929 were again diseased in 1930.

The fungus appears to enter chiefly through the top of the tree since, according to European reports, it is possible to find some trees with discolored, infected twigs whose larger branches and trunks are not infected. The rate of movement of the fungus in the tree itself varies, but it appears to be more rapid upward than downward. In several cases, seedlings showed discolored wood 15 to 20 inches above the point of inoculation and but 3 to 4 inches below it two weeks after they were inoculated. It has been possible to pass the living fungus through about 30 inches of elm twig by the use of suction. These observations make it seem likely that the spores of the organism are carried for considerable distances in the ascending sap stream. The rapid spread of the disease throughout the crown of a tree might be explained in this way in some cases.

How the parasite spreads from tree to tree is not definitely known but insects are very likely of major importance in its dissemination; the spores of the fungus have been found on the bodies and in the intestinal tract of a certain kind of elm beetle in Europe. Birds also may spread the fungus, as well as wind and rain. Experiments are contemplated on this important question.

PROBABLE SOURCE OF THE DISEASE

Is the disease native or introduced? Several considerations indicate that the parasite is not a native of this country. The diseases of elms in the upper Ohio river valley have been investigated from time to time for the last forty years by different scientists and

until last summer no fungus resembling the coremial stage of *Graphium ulmi* had been found to be associated with any of the epidemics that have occurred during that time. Moreover, American elm has been found to be among the most susceptible to the disease in Europe. Limited greenhouse inoculations of seedlings here have also demonstrated its susceptibility (Fig. 3, No. 5). If the disease had been here long, it is very likely that it would have been found earlier on either European or American elms.

It has been suggested that the drouth of last summer brought to light many cases of weakly parasitized trees which otherwise would have escaped detection. No doubt, such was the case in many instances; however, all the trees that were found suffering from the Dutch elm disease were seriously affected early in the summer before the drouth became serious. Moreover, they were shade trees that were regularly watered.

Specimens from over 300 trees sent to the Station last summer by individuals located in the general area east of the Mississippi River and north of Virginia were examined. No further cases of the Dutch elm disease were found among them.

The evidence we have is insufficient to settle the question one way or another, but it indicates that we are dealing with an imported parasite. Past experiences with imported forest parasites, such as chestnut blight, should warn us that no pains should be spared to ascertain the distribution of the disease as a basis for the formulation of control measures.

SUGGESTED PROCEDURE FOR CONTROL

There are differences of opinion regarding the resistance of some varieties of elms, but it seems that the American elm (*Ulmus americana* Linn.) is generally considered very susceptible to the disease. The Belgian (*U. hollandica belgica* Rehd.), English (*U. campestris* L.), Scotch (*U. glabra* Huds.), and slippery (*U. fulva* Michx.) elms are also said to be susceptible. On the other hand the Siberian (*U. pumila arborea* Litwinow.) and Huntingdon (*U. hollandica vegeta* Rehd., syn. *U. vegeta* Loud.) elms, as well as *U. laevis* Pall. and *U. scabra Dampieri*, are reported as showing a considerable degree of resistance to the disease. One species of the closely related genus *Zelkowa* has been found by Wollenweber (2) to be susceptible.

If further investigation of the nature and distribution of the disease should show that it is not possible to eradicate it from the

(2) Wollenweber, H. W. Stand des Ulmensterbens in Jahre 1930 in Deutschland. Sonderabdruck aus dem Nachrichtenblatt für den Deutschen Pflanzenschutzdienst M. 10, 1930.

country, it is quite likely that species, varieties, or strains of elms resistant to the disease can be selected or developed. However, on the basis of its known distribution we should not hesitate to adopt drastic measures in attempting to prevent the spread of the disease here. Complete destruction of infected trees is the only safe course to follow in the present situation.

There is no known cure for the disease although many fake treatments have been advocated. Numerous substances have been injected into healthy elms to prevent them from becoming infected or to cure them after they had become diseased. But in no instance have carefully controlled experiments shown any of these materials to be of any value.

Diseased trees are a distinct menace to all other elms. It is important, therefore, that suspected cases of the Dutch elm disease should be diagnosed as soon as possible. Specimens of wilted twigs (about the size of a lead pencil or somewhat larger and from 8 to 12 inches long) will be appreciated.

FARM TAXES

H. R. MOORE

Questions associated with taxation promise to be of unusual interest in the coming months. First, the general assembly is charged with the duty of revising the existing tax system; and second, the year 1931 is the period fixed by law for a general reappraisement of real estate for purposes of taxation.

Taxes compared with agricultural income.—Agreement is general that tax payments need to be measured in terms of income. Even though the tax base be property, it is from income that taxes are normally paid. The hazards of agriculture cause income to fluctuate from year to year; so it is opportune to inquire what the general level has been over a period of years.

Property taxes paid by farmers in 1920 were equal to approximately 9 per cent of the total net cash agricultural income in Ohio; that is, the income remaining after all cash expenses except taxes had been paid. In the succeeding years taxes rose to a new level and income declined. According to carefully calculated estimates for the period 1921 to 1929, inclusive, the total property taxes paid by farmers were equal to 21 per cent of the net cash agricultural income[1]. Slightly fewer dollars were paid in farm taxes in 1930

[1]See Bulletin 459, Ohio Agricultural Experiment Station. 1930.

than in 1929; but advance estimates indicate that at least 30 per cent of the net cash agricultural income of 1930 was paid in property taxes, due to the sharp decline in income.

Perhaps the years 1920 and 1930 represent extreme conditions which are hardly representative, but the data of the intervening nine years suffice to show that under the general run of economic conditions which have prevailed, property taxes have absorbed over one-fifth of the net cash income of agriculture.

Tax valuations should be made equitable.—This is a practical matter which concerns every farmer. The process of valuation, which under the law must be accomplished every six years, is a tremendous task for our local taxing officials. The cost is great, ranging in the last general reappraisement from $3,500 to over $300,000 in individual counties, with a total cost of approximately $2,600,000 in the whole State. Due to more complete records in the majority of counties at the present time the cost this year will probably be somewhat lower than in the 1925-1926 reappraisement. Study by the department of rural economics has indicated that more inequality in tax valuation exists between individual properties than exists between taxing districts within the same county or between counties. General adjustments to give equality between the various taxing districts are made by county auditors and the State tax commission but only the careful work of local appraisers can give equality between individual tracts of property in the same tax district, unless owners resort to the troublesome process of individual appeals.

CORN AND HAY YIELDS FOR 1930

R. E. STRASZHEIM

The drouth was the outstanding feature of the 1930 crop year.

Ohio Rainfall (Inches)

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1883–1930	3.04	2.69	3.37	3.16	3.76	4.00	3.86	3.32	2.93	2.64	2.81	2.79	38.37
1930	4.69	2.63	2.77	2.11	1.80	2.34	1.53	2.35	2.72	1.32	1.55	1.19	27.00
Deficit	+1.65	.06		1.05	1.96	1.66	2.33	.97	.21	1.32	1.26	1.60	11.37

The total rainfall deficit for the year was 11.37 inches. Every month except January had a rainfall less than average, and, from April on, the shortage was especially severe. The southern coun-

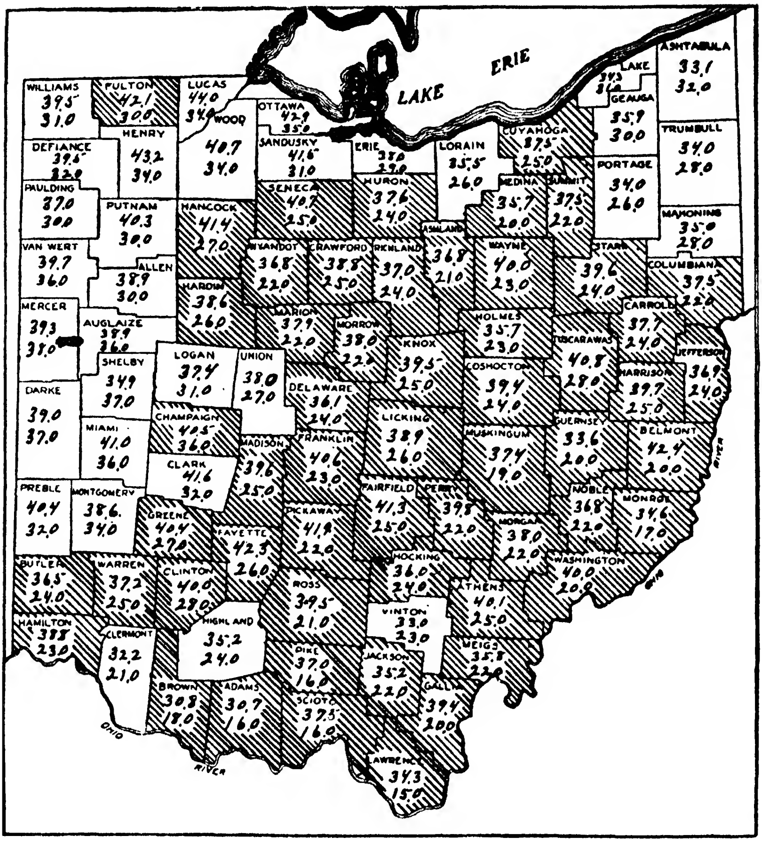


Chart 1.—Comparing the 1930 corn yields per acre with the 10-year average, 1920-1929

Upper figure—10-year average yield (Bu.)
Lower figure—1930 yield (Bu.)
Shaded counties had 1930 yield 12 bushels or more below county normal

ties suffered the most. At Wilmington in Clinton County the rainfall for the year was 23 inches, as contrasted with an average of 47 inches; during the 5 months of April, May, June, July, and August the deficit at this station was 15 inches. At Washington C. H. the precipitation for the year was 21 inches, as contrasted with an average of 40 inches.

Corn, hay, and pasture yields were seriously affected. State average yields for 1930 were as follows: corn 25.5 bushels; wheat 17.8 bushels; oats 36 bushels; hay 0.88 ton; and potatoes 90 bushels. Ten-year average yields for the same crops have been 38.8 bushels, 16 bushels, 35.1 bushels, 1.4 tons, and 93 bushels,

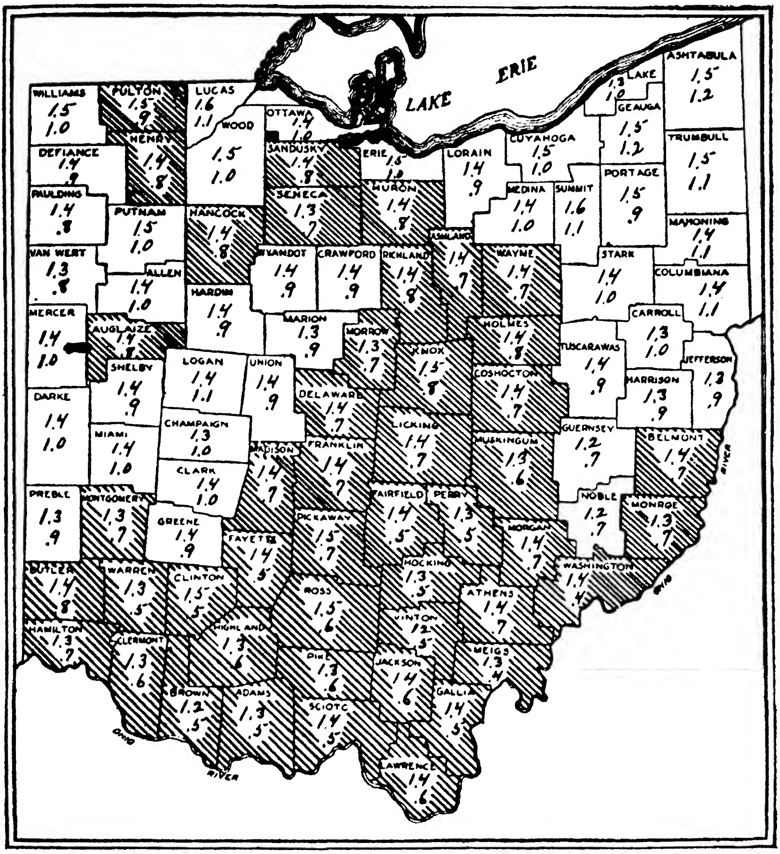


Chart 2.—Comparing the 1930 Hay (all tame) yields per acre with the 10-year average, 1920-1929
Upper figure—10-year average yield (Tons)
Lower figure—1930 yield (Tons)
Shaded counties had 1930 yield 6 tons per acre or more below county normal

respectively. Thus, it is apparent that corn and hay yields were the most seriously affected; wheat and oats yields were normal.

The accompanying charts show corn and hay yields by counties, both for 1930 and for the 1920-29 average.

These figures were secured by the Federal-State Crop and Livestock Report Service.

WHEAT AND BREAD PRICES

J. I. FALCONER

The accompanying chart shows the level of the average farm price of all wheat in the United States, of industrial wages, and of bread, by years, from 1913 to date. The bread prices used are those published by the United States Bureau of Labor. It shows

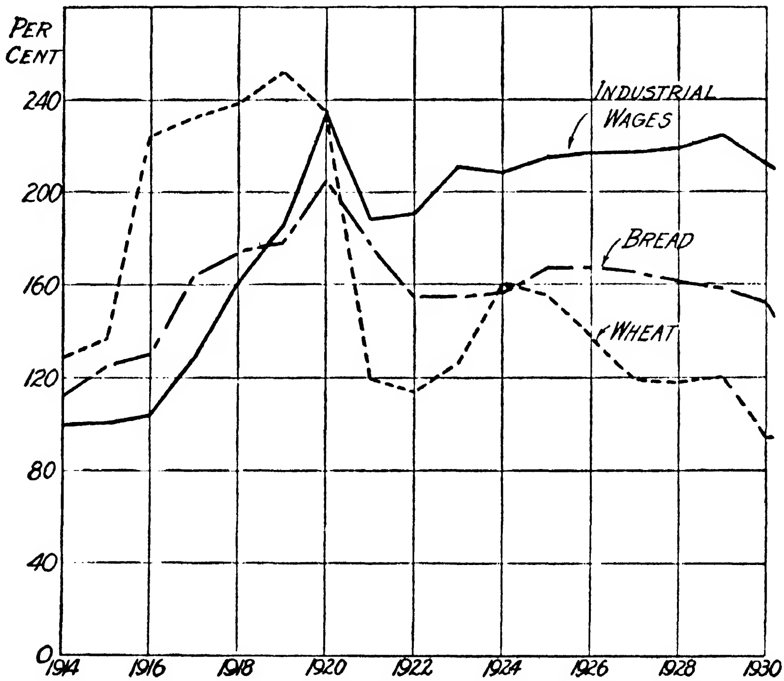


Chart 1.—The level of the average farm price of wheat, of industrial wages, and of bread, by years, from 1913 to date

that wheat is now at pre-war prices while bread prices are at a level about half way between wheat prices and industrial wages. There are many costs, other than wheat, which enter into the price of a loaf of bread before it is sold to the consumer. The Federal Trade Commission, in its report of 1928 on "Competition and Profits in Bread and Flour", presents some interesting data based upon a study made during the three years, 1922-1924. This study made in twelve states found bread retailing at approximately 8½ cents per pound, and the average price received by the farmer for a bushel of wheat to be 97 cents. On this basis the study showed that for the wheat in a pound of bread selling at 8½ cents the pro-

ducer received 1.145 cents, or 13.4 per cent of the retail price of the bread. Other costs comprised the costs and margin of the country elevator, transportation of the wheat, flour milling, the transportation of flour, the wholesale baker, and the retailer. Of the retail price for bread 25 per cent went to those agencies growing and handling the grain and flour before it was received by the bakers, 60 per cent to the wholesale baker for costs and margins above flour cost, and 15 per cent to the retail grocer for costs and margins above bread costs.

POPULATION CHANGES, 1920 TO 1930

J. I. FALCONER

In the accompanying map the figure within each county represents the percentage change in population from 1920 to 1930, as reported by the census. The shaded counties reported decreases in population, and the others an increase.

It will be noted that most rural counties show decreases in population while urban counties show increases. The total population of the State in 1920 was 5,759,394 and in 1930 it was 6,639,837; this was an increase of 880,443, or 15.3 per cent. Fifty-nine per cent of the increase in population occurred in 17 northeastern counties, including Erie, Huron, Richland, and those counties lying east. Ten counties, including Cuyahoga, Summit, Mahoning, Stark, Trumbull, Lucas, Franklin, Montgomery, Hamilton, and Butler, show a total population increase of nearly 822,000, or 93 per cent of the total increase. Forty-seven counties showed population increases, and 41 showed a decrease totalling 71,036. Trumbull County showed the largest percentage increase and Paulding County the largest percentage decrease.

Chart 1.—Percentage population change 1920 to 1930
Unshaded counties—Increase Shaded counties—Decrease

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

The price decline continued through January and February of 1931. In February of 1931 the price of Ohio farm products reached the lowest level since 1912. Fully one-half of the products of Ohio farms are now selling at pre-war prices or less. Cost items have also fallen but not to the same extent as prices received. The wages of Ohio farm labor were approximately 20 per cent less in January of 1931 than in January of 1930. In December of 1930 the United States Bureau of Agricultural Economics reported that the prices paid by farmers for commodities purchased had declined

11 per cent since December 1929. The value of farm crops produced in Ohio in 1930 was 29 per cent less than in 1929. Two-thirds of this decrease in value may be attributed to the drouth and one-third to price decline.

Trend of Ohio Prices and Wages, 1910-1914=100

	Wholesale prices all commodities U. S.	Weekly earnings N. Y. State factory workers	Prices paid by farmers for commodities bought U.S.	Farm product prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm product prices	Ohio cash income from sales
1913	102	......	100	100	104	100	105	100
1914	100	100	101	102	102	102	105	107
1915	103	101	106	100	103	107	106	110
1916	130	114	123	117	113	113	121	121
1917	181	129	150	176	140	119	182	198
1918	198	160	178	200	175	131	203	243
1919	210	185	205	209	204	135	218	266
1920	230	222	206	205	236	149	212	242
1921	150	203	156	116	164	134	132	136
1922	152	197	152	125	145	124	127	136
1923	156	214	153	135	166	122	134	149
1924	152	218	154	134	165	118	133	150
1925	161	223	159	146	165	110	159	164
1926	154	229	156	136	170	105	155	176
1927	149	231	154	131	173	99	147	163
1928	153	232	156	139	169	96	154	147
1929	151	236	155	138	169	94	151	161
1930	135	226	146	117	154	90	129	128
1929								
January	152	234	156	133	166	......	144	149
February	151	236	156	136	......	......	149	143
March	153	239	156	140	......	94	155	151
April	152	237	155	138	163	......	150	150
May	150	236	155	136	......	......	152	147
June	151	236	155	135	......	......	153	160
July	154	235	154	140	172	......	157	207
August	153	237	154	143	......	......	159	187
September	153	240	154	141	......	......	153	171
October	151	237	154	140	174	......	151	162
November	148	233	154	136	......	......	149	154
December	148	234	154	135	......	......	147	155
1930								
January	146	234	153	134	158	......	141	155
February	144	231	152	131	......	......	137	124
March	142	235	151	126	......	90	132	133
April	142	231	151	127	158	......	136	140
May	140	228	150	124	......	......	132	129
June	136	227	149	123	......	......	131	134
July	132	224	146	111	155	......	123	114
August	132	224	147	108	......	......	125	119
September	132	227	146	111	......	......	129	122
October	129	220	......	106	147	......	125	130
November	126	215	......	103	......	......	122	123
December	123	216	139	97	......	......	112	114
1931								
January	121	212	......	94	......	......	106	111
February	119	......	......	......	......	25	98	87

SPECIAL DAYS FOR 1931

C. G. Williams, Director of the Ohio Agricultural Experiment Station, Wooster, Ohio, announces the following special days to be held at Wooster: April 24, Greenhouse Vegetable Day; April 30, Livestock Marketing Day; May 1, Livestock Day; May 7, Feed Merchants' Day; June 17 and 18, County Agents' Days; June 19, Poultry Day; June 30, Wheat and Clover Day; August 4 to 7, Vocational Agriculture Teachers' Days; August 14, Dairy Day; August 20, Potato Day; August 21, Orchard Day.

Dates for Corn and Soybean Day and for Flower Day will be announced later.

In addition to the special days at Wooster, a joint livestock program has been arranged at the Madison County Farm, London, and the Ohio State University, Columbus, for April 17. At Marietta, July 11 has been set aside as Truck Day.

The Bimonthly Bulletin

July-Aug., 1931 Number 151

Ohio Agricultural Experiment Station

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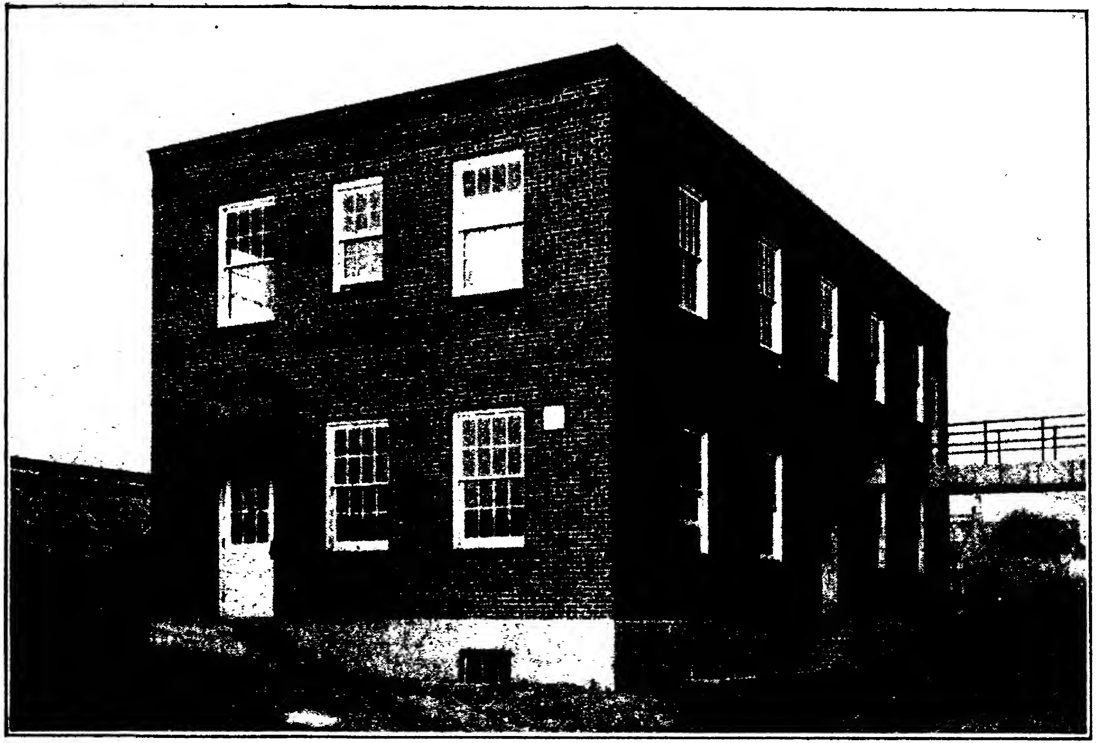
Free Bulletin

C. G. Williams

Director



The New Entomology Service Building

REMOVAL OF SPRAY RESIDUE FROM OHIO GROWN APPLES

C. S. HOLLAND

Prior to 1926, the amount of residue on sprayed fruits was generally considered to be too small to cause injurious effects to the consumer.

As early as 1891, the presence of spray residue and its possible injurious effects on the consumer were discussed by some British Journals. However, experimental work in the United States proved that the objections raised had no basis in fact, and it later became evident that the objections in England to sprayed fruit were neither very general nor very deep seated.

Representatives of the United States Department of Agriculture reopened and again closed the subject in 1922 when they reported that, after a large number of chemical analyses, the fruit sprayed according to the recommended schedule did not carry enough arsenic residue to be injurious to the consumer.

In 1926, when the question was again raised in England as to the amount of arsenic that should be permitted on sprayed fruits, the English authorities ruled that the maximum amount of arsenic trioxide that would be tolerated was .01 grain per pound of fruit. Their action fell heavily on the American apple growers who had been depending on the export trade as an outlet but, of course, did not affect the growers who were selling only on the domestic market. American authorities then set a tolerance of .025 grain per pound of fruit for the domestic trade and promised that they would gradually reduce this figure until it was .01 grain.

With the export tolerance of .01 and a domestic tolerance of .025, Ohio growers were not affected. They seldom exported apples or fruit of any kind and had no difficulty in growing apples that contained much less than the tolerance for domestic trade. However, as the figure for domestic trade was gradually reduced, the situation became different. The reductions were coming closer and closer to the amounts of residue found on our own fruit and on that grown in our neighboring states.

In 1930, the tolerance was lowered to .015 grain and the authorities promised that in the near future it would be reduced to .01. Accordingly, it was necessary to find out just how much residue was present on our apples at harvest time. Samples had

been taken by the Federal authorities in past seasons and many were taken by the Ohio Department of Foods and Dairies in 1930. Most of these samples were taken too early in the season to show the true amounts at harvest time.

AMOUNTS OF RESIDUE

In 1930, the Horticultural Department of the Experiment Station at Wooster, Ohio, had 73 samples of apples analyzed for the arsenic residue. These samples, which were taken from all sections of the State at harvest time, fairly represented the situation as it existed in that year. However, since the rainfall was far less than usual during 1930 the residue may have been higher than it would have been under normal conditions. This fact should be kept in mind. The results of these analyses are given in Table 1.

TABLE 1.—Results in Grains of Arsenic Trioxide per Pound of Apples

Southeastern Ohio		Central		Southwestern	
1 Sample	.003	1 Sample	.001	1 Sample	.005
4 Samples	.009	1 Sample	.007	1 Sample	.008
6 Samples	.01	1 Sample	.013	2 Samples	.01
2 Samples	.012				
2 Samples	.014				
1 Sample	.015				

Northwestern		Northeastern		Northeastern	
1 Sample	.002	1 Sample	.001	5 Samples	.010
1 Sample	.005	1 Sample	.002	1 Sample	.011
1 Sample	.006	2 Samples	.003	1 Sample	.013
2 Samples	.007	2 Samples	.004	1 Sample	.014
3 Samples	.008	3 Samples	.005	1 Sample	.015
3 Samples	.009	3 Samples	.006	1 Sample	.018
3 Samples	.010	1 Sample	.007		
2 Samples	.011	3 Samples	.008		
1 Sample	.02	5 Samples	.009		

It can readily be seen that the average residue is well below the tolerance of .01. A few samples exceeded .015 and a few more had between .01 and .015 grain of arsenic per pound of fruit.

RESIDUE AND THE SPRAY PROGRAM

The relation of the spray materials used and the amount of residue present at harvest time was studied in connection with some sprayed plots of the Entomology Department of the Ohio Agricultural Experiment Station. Through cooperation of J. S. Houser and C. R. Cutright, samples from these plots were analyzed.

The results are given in Table 2: They show definitely that 3 pounds of lime to 50 gallons of spray material reduced the residue on both Grimes Golden and Jonathan apples, that four sprays of

arsenate of lead brought the residue up to .01 grain of arsenic per pound of apples, that the sticker caused more residue to be present, and that oil as used had little effect in changing the residue.

TABLE 2.—Analysis of Sprayed Apples

Plot	Spray	Residue Gr.
	Grimes Golden	
5	Standard*	.010
2	Standard*	.008
3	Standard plus 3 lb. lime to 50 gal.	.007
4	Standard plus 3 lb. lime plus fish oil	.007
1	Standard plus fish oil	.010
6	Standard plus Fluxit throughout	.020
7	Standard for 3 sprays, then 2 of Verdol	.008
8	Standard for 3 sprays, then 2 dusts	.011
	Jonathan	
1	Liquid lime-sulfur, Standard*	.011
2	Liquid lime-sulfur, Standard plus lime	.006
3	Dry lime-sulfur, Standard plus lime	.009
4	Dry lime-sulfur, Standard	.010
5	Dry lime-sulfur, 3 sprays plus 2 dusts	.009
6	Dry lime-sulfur, 3 sprays plus Dutox plus oil	.005
7	Regular orchard schedule	.010
8	Regular orchard schedule plus dust August 20	.009

*STANDARD SCHEDULE

Petal Fall—Liquid lime-sulfur 1 gal.; arsenate of lead 1½ lb. to 50 gal. water.
2 weeks after petal fall—Same materials.
5 weeks after petal fall—Same materials.
Midsummer—Liquid lime-sulfur 1 gal.; arsenate of lead 1 lb. to 50 gal. of water.

Samples were also taken from sprayed plots in the Experiment Station Orchard at Wooster. When 5 pounds of lime were used to 50 gallons of spray material, the residue was again reduced. Samples from dusted plots carried less residue than those from sprayed plots. Where applications of dust were added after the liquid sprays had been applied, the residue was as great as or greater than when the liquid material alone was used.

The results of the samples analyzed showed that the average of Ohio apples carried such a small amount of arsenic residue that it was well under the tolerance of .01. However, there were some crops that ran slightly over this tolerance. In the future when this occurs, some means of removal will be necessary.

In other states where the reduction of residue tolerance has made some action necessary, the first step has invariably been to reduce the concentration of arsenate of lead in the spray, the amount of material applied to a tree, or to reduce the number of applications. The result in any case is invariably a poor control of the insect pests. Then the growers have had to change their methods, return to better spraying, and adopt some method of removing the residue at harvest time.

The solution, then, of the spray residue problem is not to reduce the amount of sprays but to remove any excess residue that may occur after good orchard practices have been followed. This plan of operation is only possible if the removal is an easy and simple process. Accordingly, studies were made to see if Ohio's removal program would differ from that of the other states where washing has been adopted.

TESTS FOR OHIO CONDITIONS

Pioneer work on spray residue removal was done in the northwestern fruit states. Cleaning by wiping was first tried and discarded in favor of washing with solvents. It was concluded that removal of spray residue by wiping and brushing was not practical. Removal by washing with hydrochloric acid was the most satisfactory plan. These conclusions have been substantiated by work done in various sections of the United States.

Several tests were made to learn the best method of residue removal under Ohio conditions.

TABLE 3.—Results of Wiping Machines

	Arsenic residue in grains	
	Before cleaning	After cleaning
Lawrence County	.014	.010
Lucas County	.005	.002

Dry cleaning with commercial wiping machines was found to remove 30 per cent of the original arsenic residue. This is identical with results reported in the Northwest.

While a reduction of 30 per cent of the residue may in some cases be sufficient to justify the use of wiping machines, in general, they cannot be considered a practical solution of the problem. Their use will cause a reduction on the most heavily coated fruits but may not on the lightly covered ones.

Furthermore, the wiper will not meet emergency cases that may occur in a season of light rainfall, as in 1930. Certainly, the wiping machine is not to be recommended as a fully satisfactory means of removing spray residue under Ohio conditions.

WASHING WITH SOLVENTS

The use of dilute hydrochloric acid as a solvent for the residue was found to be very effective. It removed 80 per cent of the original residue, did not disturb the bloom, and, when it was well

rinsed, did not affect the keeping qualities. This material has proved so much more effective than other solvents that it seems to be the only one that should be considered under present conditions.

TABLE 4.—Strength of Acid to Remove Arsenic

Results in grains of arsenic trioxide per pound of apples

Treatment	None	4 min.	3 min.	2 min.	1 min.
2% HCl (by volume)	....	.005	....	....	....
1% HCl (by volume)	....	.005	.006	.006	.013
½% HCl (by volume)	....	.013	.013	.015	.020
No washing	.021	....	....	....	....
No washing	.026	....	....	....	....

Tests to determine the optimum strength of the acid showed that 1 per cent, by volume, of commercial acid for 3 minutes was the weakest solution that was effective. The results of these tests can be seen in Table 4.

METHODS OF WASHING

Dipping.—Dipping a crate of apples in the acid and then in a rinse bath of water would be the simplest means of washing. However, it has several objections. The process is laborious, takes considerable time, and may cause injury on open calyx varieties when the fruit is submerged. This injury is due to the acid being forced into the calyx and causing a characteristic browning. In the tests made with the Rome Beauty variety, no injury was noted from the submersion.

TABLE 5.—Dipping and Flotations as Methods of Removing Spray Residue. Duchess Apples Dipped in Arsenate of Lead Before Washing

Before washing	.017 grain of arsenic trioxide per pound
Submersion	1% HCl—4 min.—.003 grain
Submersion	2% HCl—4 min.—.003 grain
Before washing	.015
Flotation	1% HCl—4 min.—.003

Rinsing is very important because it is the only way to prevent the acid from burning. Running water should always be used for rinsing.

The only advantage of dipping is that it does not require a very great expenditure for equipment. This method is only to be considered if nothing else is available.

Flotation.—In order to meet the demands for a cheap, apple washing machine, the United States Department of Agriculture has published a mimeographed bulletin describing in detail a machine for washing apples by a flotation method. The apples are

floated first through the acid bath and then through the rinse water. They must then either be packed wet or run into crates and allowed to dry.

The advantages of this machine are that it will handle about 80 bushels an hour, is cheap, and is efficient in removal of the residue. The disadvantages are that it is apt to bruise the fruit, and the machine cannot be as well built as one that is made in a factory.

The commercial washing machine.—There are now on the market washing machines that will cost only a little more than the home-made flotation type of washer. These machines generally use a system of spraying the acid and rinse water on the fruit as it passes along on conveyors. As the fruit leaves the rinse bath, it goes through a dryer of some kind and comes out ready to pack.

Rome Beauty apples, stored in the cold storage at the Ohio State University and in the common storage of the Ohio Orchard Company, showed that the washing process had not affected the keeping qualities even though the fruit was stored wet. This may not always be the case and it would certainly be best to dry the fruit before it is stored. Where the commercial machines are used the fruit is dried mechanically, but where no dryer is available, the fruit should be put into crates and allowed to stand before storing or packing.

The time for washing is immediately after harvest. If the fruit is put into storage and allowed to form a wax coating, the residue is often hard to remove.

OTHER BENEFITS

Washing properly done will remove dirt, residue from insects, and objectionable spray materials. In other words, it will thoroughly clean the fruit for human consumption so that in the future growers may be forced by competition to wash their fruit whether the arsenical residue demands the operation or not.

Certain it is that growers must not reduce their spraying operations because of a fear of facing the residue problem. They must spray thoroughly enough to control the insect and disease pests and then adopt a means of residue removal that will prepare the fruit for market. The method of washing will depend entirely on the quantity of apples to be treated. Dipping should be used only as a last resort. Washing with a machine will prove satisfactory for the commercial orchardist.

MEETING THE SITUATION

The Ohio fruit grower must meet the spray residue problems squarely and must consider the practical steps to meet the situation.

1. He must have analyses of his fruit made to learn how much residue it contains. This is necessary because the Ohio apples are so close to the border line. Most of them will never have to be washed unless additional arsenical sprays become necessary but some may have to be washed every year.

2. The type of washer will vary with the volume of fruit to be handled. The commercial washing machines can be used to advantage when over 6000 bushels are handled.

3. For a volume of less than 6000 bushels, a grower may either cooperate with his neighbors, use a home-made washer of the flotation type or a commercial machine without the dryer. All of these suggestions are made to provide for a reasonable machinery cost per bushel.

4. Where the residue is between .01 and .015 grains per pound of fruit, a wiper may be used as a temporary cleaning device. It must not be considered as permanent because a dry season, unusually small fruit, or additional spray applications may cause it to be unsatisfactory as a means of residue removal.

EARLIER BLOOMING BY SHADING CHRYSANTHEMUMS

ALEX LAURIE

The chrysanthemum is classed as a "short day" crop—one which matures during the shorter days of the year. Because of this tendency it has become possible to shorten the season of growth of many varieties and to force them to come into flower weeks in advance of their normal season. Practically, out-of-doors and in the greenhouse, the method has unlimited possibilities. At present, the use of hardy chrysanthemums in gardens is limited to certain favored localities and a few early varieties, due to the fact that frost usually occurs before flowering. By applying shade to our outdoor varieties for a period of 4 hours per day during the month of July, the flowering season may be advanced from late

October to mid-September and thus the danger of frost may be eliminated and autumnal colors introduced in the garden at a time when little bloom is available.

The actual process consists of placing a light-proof box over the plants in the ground at about six o'clock at night and removing it at seven next morning. This may be varied by using a wooden framework over which black cloth is stretched. By means of this shade the actual daylight is reduced by 4 hours, and the plants soon show signs of maturity and flowering.

In the greenhouse the method has a definitely profitable aspect. It enables the grower to bring midseason varieties in bloom in September and early October when only the smaller types are available.

The shading in the experiments reported here was accomplished by entirely enclosing the plants with a black sateen cloth. The sides and ends were shaded by means of curtains which were attached to wire supports three and one-half feet above the bench. The top was covered with portable frames upon which the black sateen cloth was tacked. By shading the plants in the above manner little light was received by the plants.

The price of application and the removal of the shade was very small. Two men put the shades on in the afternoon and removed them in the morning in fifteen minutes. This time could easily be reduced if larger plots were being shaded.

The plants were all planted June 16. The varieties used were Golden Glory, Gladys Pearson, Silver Sheen, and Rose Perfection. Five plots were tried in this test. There were 30 plants of each variety or 120 plants in each plot. All plants were grown to single stem.

The plots were treated in the following manner:

Plot I.—Shading was started July 26. Shades were placed at 6 P. M. and removed at 7 A. M. each morning.

Plot II.—Check plot, received no shading.

Plot III.—Shading was started June 26, 10 days after planting. Shades were placed at 6 P. M. and taken off at 7 A. M. each morning. The day was reduced by 4 hours.

Plot IV.—Shading started June 26, the same as in Plot III. Shades were placed at 5 P. M. and taken off at 7 A. M. each morning. In this way the day was cut 5 hours shorter.

Plot V.—Shading was started June 26, the same as in Plots III and IV. Shades were placed at 4 P. M. and taken off at 7 A. M. each morning. The length of day was reduced 6 hours.

The shading was discontinued on all plots on September 2. This was due to the fact that the terminal buds were present on all the shaded plots. Later shade application would result in retarding of flowering.

Results

Plot No.	Variety	Date of formation of terminal bud	Date buds showed color	Date of cutting	Av. length of stem flower	Av. diameter of flower	Days cut before check
1	Golden Glory	Aug. 25	Sept. 8	Sept. 29	35 in.	6 in.	25
	Gladys Pearson	Sept. 3	Sept. 21	Oct. 6	46 in.	6½ in.	49
	Silver Sheen	Aug. 25	Sept. 6	Sept. 15	31 in.	6 in.	36
	Rose Perfection	Aug. 25	Sept. 6	Sept. 23	36 in.	5½ in.	38
2 Check	Golden Glory	Sept. 10	Oct. 6	Oct. 24	40 in.	5 in.	....
	Gladys Pearson	Oct. 4	Nov. 4	Nov. 24	58 in.	6¼ in.	....
	Silver Sheen	Sept. 10	Oct. 6	Oct. 21	40 in.	5¾ in.	....
	Rose Perfection	Sept. 10	Oct. 13	Oct. 31	42 in.	6 in.	....
3	Golden Glory	July 15	Aug. 23	Sept. 15	24 in.	5½ in.	39
	Gladys Pearson	Aug. 26	Sept. 15	Oct. 6	44 in.	6 in.	49
	Silver Sheen	July 15	Aug. 14	Sept. 5	20 in.	5½ in.	46
	Rose Perfection	July 15	Aug. 19	Sept. 5	22 in.	5½ in.	56
4	Golden Glory	July 21	Aug. 26	Sept. 15	25 in.	5 in.	39
	Gladys Pearson	Sept. 3	Sept. 29	Oct. 13	45 in.	6¼ in.	42
	Silver Sheen	July 21	Aug. 28	Sept. 15	24 in.	5½ in.	36
	Rose Perfection	July 21	Aug. 28	Sept. 15	27 in.	6 in.	46
5	Golden Glory	July 28	Aug. 28	Sept. 15	27 in.	5½ in.	39
	Gladys Pearson	Sept. 3	Oct. 4	Oct. 15	45 in.	6¼ in.	40
	Silver Sheen	Aug. 18	Sept. 1	Sept. 15	28 in.	6 in.	36
	Rose Perfection	Sept. 2	Sept. 15	Sept. 29	38 in.	6 in.	32

Shading brought the chrysanthemum into flower from 22 to 56 days earlier than the check which received no shading. The diameter of the flower was as large as and in some cases larger than the check. Shading resulted in shorter stems but the stem length was long enough to make the flowers salable. The decrease in stem length can be accounted for, at least in part, by the fact that the plants under the shade did not form any crown buds but produced terminal buds instead.

These preliminary tests show that the best time to apply the shade is one month after planting the chrysanthemums in the bench. Plot I serves as an illustration. Much longer stems were secured in this case and the flowers were cut about the same time as in the other shaded plots which were shaded one month longer.

The shades may be applied at 6 P. M. and removed at 7 A. M. in the morning. This cuts the length of day 4 hours which is sufficient to make the plant flower earlier. By cutting the length of day 5 or 6 hours, the chrysanthemums were not brought into flower any earlier.

Shade should be removed when the terminal bud appears; otherwise retarding of flowering will take place. Light is necessary for opening of buds.

Another experiment was tried with potted pompons. The shade was started September 5 and discontinued October 9. Here again the length of day was reduced 4 hours. All varieties used, including Wee Dot, Irene, Juliana, Dora, Sadie Mason, Christmas Gold, and Chestnut, were brought into flower 7 to 9 days ahead of the non-shaded plot.

This shows that late shading is not so beneficial as shading in the middle part of the growing season, for the chrysanthemum.

Stevia was treated for 3 weeks after planting in the greenhouse in a similar manner, and it matured in perfect condition 4 weeks earlier.

RETURNS PER ACRE IN CATTLE FEEDING. PART III

PAUL GERLAUGH AND H. W. ROGERS

During the winter season of 1928-1929 two lots of yearling steers, fed at the Madison County Experiment Farm, showed returns of $71.65 per acre of corn when the corn was fed in the form of silage and $50.80 per acre when a similar area of corn was fed as shelled corn and stover. (Bimonthly Bulletin 139).

The following year an acre of corn returned $56.66 when fed as silage and $57.06 when fed as half a full feed of silage and the cattle were given, in addition, as much shelled corn as they wanted. While in this test the lot fed a full feed of silage did not make quite as high returns per acre as the lot fed silage and shelled corn, there was much reason to think that in the majority of cases the cattle full fed silage would have returned more per acre than the other lot.

The drouth of 1930 materially reduced the prospective yield of both corn and silage at the farm. General business conditions indicated that a conservative policy might be preferable in cattle feeding. There were many inquiries which asked whether a home-grown legume hay and a full feed of corn silage would produce satisfactory results. Consequently, for the 1930-1931 test, Lot I was again fed a full feed of corn silage, 2 pounds of cottonseed meal, and as much first-year sweet clover hay as they wanted. This ration, with the exception of the variety of the hay, was the same as that fed to the corresponding lot during the 2 preceding years.

Lot II was fed a full feed of silage and a full feed of the first-year sweet clover hay. Two pounds of shelled corn were fed to this lot to replace the similar amount of concentrate fed to Lot I in the form of cottonseed meal.

The sweet clover hay was of excellent quality. In spite of the drouth, the low, dark soil spots of the field from which wheat had been cut grew a reasonable quantity of the hay. Rain did not interfere at the time of cutting the hay. A few wheat stubbles were the only foreign material contained in the hay. No troubles were experienced from the feeding of this hay to the cattle.

The accompanying table shows the yield of grain and silage and the performance of the cattle.

Summary Madison County Cattle Feeding Test, 1930-1931

Yearling steers fed 165 days—October 31 to April 14

	Lot 1 Corn silage 1st year sweet clover hay Cottonseed meal	Lot 2 Corn silage 1st year sweet clover hay Shelled corn
Number of steers per lot	12	12
Cost of cattle at farm	$ 8.05	$ 8.05
Average weight, Oct. 31, lb.	783	785
Average weight, April 14, lb.	1192	1125
Average daily rations, lb.:		
Corn silage	59.7	54.3
1st year sweet clover hay	3.23	3.49
Cottonseed meal	1.98	....
Shelled corn	....	1.96
Average daily gain, lb.	2.47	2.06
Steer days fed per acre of corn	219	241
Acres corn to feed steer 165 days	.753	.684
Beef per acre of corn fed, lb	541	496
Pork per acre of corn fed, lb.	19	28
Total pork and beef per acre of corn fed, lb.	560	524
Feed required for 100 lb. gain, lb.:		
Corn silage	2417	2633
1st year sweet clover hay	131	169
Cottonseed meal	80	....
Shelled corn	....	95
Cost of 100 lb. gain	$ 8.14	$ 8.71
Profit per steer, pork included	−$ 5.80	−$ 8.82
Returns per acre of corn, pork included	$22.15	$16.50
Market appraisal on basis of feed lot weights	$ 7.50	$ 7.33
Market valuations: Pittsburgh	$ 8.50	$ 8.25
Market valuations: Cleveland	$ 8.00	$ 8.00
Market valuations: Cincinnati	$ 8.25	$ 8.00

Yields—Silage, 6.66 tons per acre, put into silo; 6.54 tons per acre fed.
Grain, similar corn allowed to ripen husked 34.8 bushels per acre.
Prices—Silage, $4.50; hay, $20.00; cottonseed meal, $35.00; shelled corn, $0.65; hogs, $8.00.

Lot I gained 2.47 pounds daily for the 165-day feeding period. This is a larger gain than obtained from a similar ration in previous years. The cattle used in this test were 120 pounds heavier than those used the previous year. The daily consumption of silage was greater than previously; the size of the cattle was probably responsible for this situation.

The cattle in Lot II had a similar ration except that 2 pounds of shelled corn replaced the 2 pounds of cottonseed meal. The steers did not eat as much silage as the Lot I steers, nor did they gain as well. The cottonseed meal was a very good investment in this test. Some observers felt that Lot I had gotten the "breaks" at the time of allotment. More work is needed to verify this point.

There was less corn in the silage than in the previous test. This is chiefly responsible for the relatively lower amount of pork per acre of corn fed.

Lot II in the 1930-1931 test

The returns from the cattle are figured on the basis of the values given. The cattle actually sold at $7.50 per cwt. for both lots to the Columbus Packing Company. The cattle were weighed at London, about 4 miles from the farm. On the basis of these weights the cattle in Lot I dressed 58.7 per cent and Lot II dressed 57.0 per cent. The carcasses were satisfactory in color and firmness.

Lot I sold for 55 cents per cwt. less than their feed lot cost. With this handicap they returned 64 cents per bushel for the corn which they consumed. An efficient utilization of the corn was responsible for this situation. We feel that the silo was the chief contributor in making this showing possible.

RETURNS PER ACRE IN CATTLE FEEDING

Summary of Three Years' Work

PAUL GERLAUGH AND H. W. ROGERS

The accompanying table summarizes the results of 3 years' work at the Madison County Farm, where silage has been full fed to a lot of yearling steers during each of the 3 years. During the first year the second lot of cattle was full fed shelled corn with no silage in the ration. A ration of half a full feed of silage and as much additional shelled corn as wanted was fed to the second lot the second year; while during the third trial the second lot had 2 pounds of shelled corn substituted for 2 pounds of cottonseed meal, with both lots being full fed both silage and first-year sweet clover hay.

The table shows a relationship for Lot I during the 3 years between the size of the cattle and their feed consumption. This influences the rate of gain. There is also a close relationship in the amount of feed required to produce 100 pounds of gain. The longer the feeding period the greater would be the amount of feed necessary to produce 100 pounds of gain, and heavy cattle require more feed per unit of gain than lighter cattle.

This test indicates that the tonnage of silage is a more important guide to gains per acre than is the yield of corn.

The figures are shown for Lots I and II for the 3 years of the test, using the actual cost and selling price of the cattle, the actual yields, and the feed prices which were used in the test. An average of the 3 years is also shown for Lot I. No average is shown for Lot II because of the variation in the rations used.

The dressing percentages are not comparable one year with another, because some of the selling weights were at home and others at the market.

Returns per acre have been calculated, using the same price for feeder cattle for both lots each of the 3 years. Seven dollars per cwt. was chosen as a feed lot cost. According to a statement in Chicago Daily Drovers' Journal (May 4, 1931) the average margin between October feeder cattle prices and April fat cattle prices over a period of the last 8 years has been \$3.15. This margin prevailed in the yards. We have used a feed lot margin of \$1.50 per cwt. for the Lot I cattle in each of the 3 years. With a cost of \$7.00 per

Madison County Cattle Feeding Experiment—Three-year Summary

	Lot 1				Lot 2		
	1928–1929 174 days	1929–1930 177 days	1930–1931 165 days	Average of three years	1928–1929 174 days	1929–1930 177 days	1930–1931 165 days
Number of steers per lot	14	14	12	.....	10	10	12
Cost of steers in feed lot	$13.50	$10.50	$ 8.05	.....	$13.50	$10.50	$ 8.05
Average weight at start of test, lb.	622	662	783	684	607	662	785
Average weight at close of test, lb.	971	1036	1192	1060	998	1107	1125
Average daily gain, lb.	2.01	2.11	2.47	2.18	2.24	2.51	2.06
Average daily ration:							
Silage, lb.	47.4	49.4	59.7	51.7	.....	24.9	54.3
Shelled corn, lb.	.....	.....	.....	.....	16.3	11.9	1.96
Cottonseed meal, lb.	2.0	1.96	1.98	1.98	2.0	1.96	.....
Hay, lb.	1.2	2.78	3.23	2.37	1.6	2.06	3.49
Stover, lb.	.....	.....	.....	.....	9.5	7.7	.....
Feed required per cwt. gain:							
Silage, lb.	2370	2339	2411	2371	.....	989	2633
Shelled corn, lb.	.....	.....	.....	.....	727	475	95
Cottonseed meal, lb.	100	92.9	80	89	89	78	.....
Hay, lb.	60	131	131	109	71	82	169
Stover, lb.	.....	.....	.....	.....	424	304	.....
Cost per cwt. gain	$10.22	$ 8.01	$ 8.14	$ 9.44	$15.75	$10.51	$ 8.71
Profit per steer, pork included	$ 8.58	$11.79	—$ 5.80	$ 5.38	$ 3.46	$13.69	—$ 8.82
Yield per acre:							
Tons of silage	8.8	8.3	6.66	7.92	8.8	8.3	6.66
Bushels of corn	48.0	63.0	34.8	48.6	48.0	63.0	34.8
Steer days fed per acre of corn	375	337	219	306	166	205	241
Cattle gains per ton of silage, lb.	85.4	85.7	81.2	84.4	.....	.....	.....
Cattle gains per acre of corn, lb.	752	712	541	668	372	515	496
Gains on hogs per acre of corn fed to cattle, lb.	39	28	19	29	67	66	28
Gain on cattle and hogs per acre of corn, lb.	791	740	560	697	439	581	524
Returns per acre of corn, pork included	$71.65	$56.66	$22.15	$47.29	$50.80	$57.06	$16.50
Returns per bushel of corn, pork included	$ 1.49	$ .90	$ .64	$ .99	$ 1.06	$ .91	$ .47
Feed lot selling price (Pittsburgh basis)	$14.00	$10.60	$ 7.50	.....	$14.75	$11.25	$ 7.33
Dressing percentage (weights not comparable)	59.6	Not certain	58.7	.....	60.6	Not certain	57.0

Above is shown the actual performance and returns of the cattle as reported each year. The average performance of Lot 1 is shown. Lot 2 is not averaged because of lack of similarity of ration.

Prices used above:	(1928-1929)	(1929-1930)	(1930-1931)
Shelled corn	$ .90 per bu.	$ .65	$ .65
Corn stover	5.00 per ton	4.00	......
Corn silage	6.00 per ton	4.50	4.50
Hay	15.00 per ton	10.00	20.00
Cottonseed meal	55.00 per ton	45.00	35.00
Hogs	11.00 per cwt.	10.00	8.00

Madison County Cattle Feeding Experiment—Three-year Summary—Continued

	Lot 1				Lot 2		
	1928–1929 174 days	1929–1930 177 days	1930–1931 165 days	Average of three years	1928–1929 174 days	1929–1930 177 days	1930–1931 165 days
Value of cattle gains per acre of corn	$68.05	$63.01	$51.58	$60.80	$38.61	$52.63	$41.71
Value of hog gains per acre of corn	$ 2.73	$ 1.96	$ 1.33	$ 2.03	$ 4.69	$ 4.62	$ 1.96
Returns per acre of corn fed to cattle, hogs included	$70.78	$64.97	$52.91	$62.83	$43.30	$57.25	$43.67
Returns per bushel of corn fed to cattle	$ 1.47	$ 1.03	$ 1.52	$ 1.25	$ .90	$ .91	$ 1.25

Above are shown the returns for the 3 years on the basis of $7.00 per cwt. as the feed lot cost of the feeder cattle each year; $8.50 per cwt. is used as the feed lot selling value of Lot 1 for each of the 3 years. $9.00 per cwt. is used as the feed lot selling value of Lot 2 for the first 2 years and $8.25 per cwt. as the value of Lot 2 for the third year of the test. The actual yields of grain and silage and the actual ration and gains of cattle and hogs are used. Hay is valued at $10.00 per ton, cottonseed meal at $35.00 per ton, and hogs at $7.00 per cwt. in the above calculations.

cwt. as feeders this margin would give them a feed lot value of $8.50 per cwt. at the close of the test. Lot II in the 1928-1929 test was valued at $14.75, while Lot I was valued at $14.00. This margin of 75 cents per cwt., on the basis of $14.00 cattle, would be similar to a 50-cent margin on the basis of $8.50 cattle. We have, therefore, assumed that $9.00 would be a fair value to use on Lot II for the year 1928-1929.

In the 1929-1930 test Lot II was actually valued at $11.25 when Lot I was valued at $10.60. This margin of 65 cents on the basis of $10.60 cattle is thought to be similar to a 50-cent margin on $8.50 cattle; so we have placed a $9.00 value on Lot II for the second year, to compare with $8.50 for Lot I.

Using these assumed values on the cattle shows that silage is a very economical feed for fattening yearling steers. When combined with hay and protein supplement a ton of silage has given 80 to 85 pounds of gain on cattle. The length of feeding period has been from 165 to 177 days and the average daily gain over 2 pounds.

No trouble has been experienced with any of the cattle killing off color. The cattle on the first test were killed in Cleveland; a Pittsburgh butcher killed the cattle the second year; and the 1930-1931 cattle were slaughtered in Columbus. There has been nothing objectionable in the carcasses of the cattle full fed on silage.

It is interesting to note that the Lot I cattle during the 1930-1931 season actually sold for 55 cents less in the feed lot than their feed lot cost. These cattle, after paying $35.00 per ton for the cottonseed meal and $20.00 per ton for the hay consumed, returned 64 cents per bushel for the corn crop fed them. This would certainly be considered a strong recommendation for silage as a feed for fattening yearling steers.

The lower lines of the table show that even with beef cattle prices on a low level, as compared with the past several years, a silo can help materially in increasing the returns from the corn crop.

Cutting cost of production in cattle feeding operations seems to hold more promise for profit than increasing the selling value to cover cost of production, regardless of feeds and methods used.

Cost of production is a more important factor than rapidity of gain or market-topping ability when ready to sell.

If there are any serious objections to the full feeding of silage, the 3 years which this test has run have failed to bring them to the surface.

The work has shown an excellent increase in returns when silage has been used extensively; in fact, the more extensive, the more profitable.

The quality of the silage has been excellent, considering the seasonal conditions prevailing when the corn was grown.

We think that if a farmer wants good silage he should handle the corn crop just as he would for a good crop of crib corn and then put it into the silo instead of shocking it to husk and crib later.

HAND-FEEDING VS. SELF-FEEDING FATTENING LAMBS

D. S. BELL

The object of the 1929-1930 lamb feeding tests was to study the principles involved in using self-feeders for offering both concentrates and roughages to fattening lambs. For this test 210 white-faced Montana lambs, averaging about 65 pounds in weight and grading as good to choice feeding lambs, were secured on the Union Stock Yards, Chicago, Illinois. These lambs were allotted into eight comparable groups of 26 lambs each and started on test on November 14, 1929.

The plan of the test called for the use of self-feeders for allowing concentrates and roughages (separately) to four lots of lambs; the other four lots were hand-fed. Four feeding practices were involved in the test, one lot each of hand-fed and self-fed lambs demonstrating one of the four practices. Table 1 presents in outline form the schedule for feeding concentrates to each group.

The general plan of the experiment was based on the fact that most experiments and farm experiences have shown that shelled corn cannot be placed in self-feeders before lambs at the outset of feeding without the hazards of illness and probable death.

On the other hand, some investigators and farmer feeders have used whole oats in self-feeders right at the start. Others have called our attention to their success in offering lambs corn-and-cob meal (ground ear corn) in self-feeders practically from the very start. The theory is that oats, being about 33 per cent hull by weight, and corn-and-cob meal, being 20 per cent cob by weight—both more by measure—are bulky feeds, and because of this bulkiness the hazards from overeating on the part of the lambs are minimized. Later in the feeding period a higher percentage of corn is included in order to bring the lambs to high condition.

TABLE 1.—Feeding Plan for Grain

	Hand-fed lots				Self-fed lots			
Period of starting on concentrates	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6	Lot 7	Lot 8
4-5 weeks	Oats	Oats	Corn-and-cob meal	Corn-and-cob meal	Oats	Oats	Corn-and-cob meal	Corn-and-cob meal
Period for changing from starting grain to finishing grain 4-5 weeks	From oats to oats and corn 1:1	From oats to corn alone	From corn-and-cob meal to corn-and-cob meal and corn 1:1	From corn-and-cob meal to corn alone	From oats to oats and corn 1:1	From oats to corn alone	From corn-and-cob meal to corn-and-cob meal and corn 1:1	From corn-and-cob meal to corn alone
Period for finishing 4 weeks	Oats and corn 1:1	Corn alone	Corn-and-cob meal and corn 1:1	Corn alone	Oats and corn 1:1	Corn alone	Corn-and-cob meal and corn 1:1	Corn alone

In the above table, "corn" indicates shelled yellow corn of No. 2 grade.
Also, 1 pound of linseed oil cake was mixed with each 10 pounds of other concentrates.

RESULTS

Instead of obtaining results on the efficiency and economy of hand-feeding vs. self-feeding or securing data on the rate, character, and cost of gains from the various rations employed, the test resolved itself into one of causes of death among fattening lambs. Altogether, 29 out of 210 lambs died and 25 of these deaths occurred in the self-fed lots. This discussion is, therefore, purposely limited to the procedures followed and postulation of a theory on the cause of death among the lambs, particularly those self-fed.

HAND-FEEDING

The mortality among the hand-fed groups was minor compared to that among the self-fed lots. One lamb from each of Lots 1 and 2 died at the end of the first week on feed. These two deaths were attributed to acute digestive disorders resulting from allowing too great a quantity of concentrates at the initial feeds. At the outset these lambs were allowed $\frac{1}{4}$ pound of oats and 0.1 pound of linseed oil cake per head at each feed. If every lamb would consume its allotted share a digestive upset could scarcely occur. When fed as a group, however, there is nothing to prevent some lambs from eating too much if part of the lambs remain indifferent towards grain. This occurrence calls attention to the necessity for caution in starting lambs on concentrates, even with a bulky grain like oats and emphasizes the importance of allowing only a "sprinkle" of grain in the trough until all the lambs get the "taste".

SELF-FEEDING

The self-feeders containing the planned concentrate mixture of grain and linseed oil cake for each lot, respectively, were opened at the outset for Lots 5, 6, 7, and 8 but only after the lambs had been given all the clover hay they would consume. Most western lambs that have never tasted grain and have full stomachs from other feeds allowed maintain an indifferent attitude toward grain when it is first presented to them. Part of these lambs, however, set to work immediately, even though they had satisfied their appetites for hay, and ate such amazingly large quantities of grain that the feeders were closed after only a few hours. Five lambs died and fully half of the lambs in each self-fed lot were ill from digestive disorder. The self-feeders were kept closed, the lambs were rested from grain for a few days, and then started by careful hand-feeding, which was continued until 26 lambs were eating 44 pounds

TABLE 2.—Mortality of Feeding Lambs by Half-week Periods—Hand- vs. Self-feeding

Lot No.	No. lambs	Nov. 14–21		Nov. 21–28		Nov. 28–Dec. 5		Dec. 5–12		Dec. 12*–19		Dec. 19–26		Dec. 26–Jan. 2		Jan. 2–9		Jan. 9–16		Jan. 16–23		Jan. 23–30		Jan. 30–Feb. 6	
1	26	......	1	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	......	......
2	26	......	1	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	......
3	26	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
4	26	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
5	26	......	......	2	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	1	......	1	......
6	26	......	......	1	......	......	1	......	......	......	......	......	......	......	......	......	......	......	......	......	......	6	4	......	......
7	26	......	......	......	......		......	......	......	2	......	......	......	......	......	......	......	......	......	......	......	2	......	......	......
8	26	......	2	......	......	......	......	......	......	1	......	......	......	......	......	......	......	......	......	......	......	1	1	......	......

*Started self-feeders Dec. 12; started changing feed Dec. 31; onto finishing ration Jan. 20.

daily of their respective 10:1 mixture. The self-feeders were again opened, with less disastrous results, but not without the loss of three lambs in the lots self-fed corn-and-cob meal.

For 6 weeks after the self-feeders were opened this second time the self-fed lambs made rapid but not economical gains. At the end of this 6-week period and nearly 2 weeks after they went on their finishing concentrate mixture, a heavy death loss was sustained—16 lambs died in a few days. In some instances lambs died within a few minutes after the first noticeable symptoms of illness, while in other cases a sudden and complete loss of sensation and of the power of voluntary motion, followed by death in a minimum of 36 hours, was characteristic.

These symptoms tally with those frequently given by lamb feeders in describing death loss without apparent symptoms of illness, which takes nearly-fat lambs from the feed lot. The history is usually to the effect that the most forward lambs which are rounding into prime market finish with amazing swiftness are stricken. The disease has been grossly termed "apoplexy", not because there is any evidence that brain hemorrhage has occurred, but because of the suddenness of the death, or evidence of paralysis in the form of loss of sensation and the power of voluntary motion.

Gross and laboratory examination of the dead lambs revealed nothing that seemed significant or indicative of infectious disease. Also, the symptoms did not indicate poisoning from damaged feed, nor did the feed upon inspection show any appreciable evidence of inferior quality or damage; but even so, the feed was tested and it proved wholesome.

Table 2 shows the mortality occurring in each lot, the distribution of this mortality by half-week periods, and the relation of the occurring mortality to the time the various changes in the ration were made.

Table 3 shows the proportion of roughage to concentrates consumed by the lambs during each of the three major periods of the test, along with the average daily gain of the lots during these three periods.

A study of these two tables, with reference to the "apoplectic" losses in the 11th and 12th week, shows that in Lot 6, where the highest mortality occurred, the lambs were eating heavily of concentrates and very lightly of the clover hay offered. This relative intake of concentrates to roughages maintained even during the Changing Period for this lot. Lots 3 and 4, which were hand-fed, showed no mortality and likewise a narrower proportionate intake

of concentrates to roughages. Aside from the one lamb which died in Lot 1, the data indicate mortality occurring in those lots where the proportion of roughage to concentrate exceeded a 1:2.3 ratio, with the mortality rate increasing as this proportion of roughage to concentrate widened. Individual weights are not available to check the rate of gain of these individuals that died against that of the lambs that lived, or against the average for the lot. Because the data are insufficient in some respects they do not definitely verify the theory of losses from so-called "apoplexy" on the basis of heavy concentrate intake accompanied by very rapid gains in weight prior to the occurrence of death. The evidence seems to lend weight to that theory, however, and the possibility of this, or some related factor, being the explanation will form the basis of a future lamb feeding test.

TABLE 3.—Proportion of Roughage to Concentrates Eaten by the Lambs

	Period					
	Starting—4 weeks		Changing—5 weeks		Finishing—2 weeks	
	Proportion of roughage to concentrate	Average daily gain for period	Proportion of roughage to concentrate	Average daily gain for period	Proportion of roughage to concentrate	Average daily gain for period
		Lb.		*Lb.*		*Lb.*
Lot 1 Hand-fed	1:0.413	.221	1:1.04	.144	1:1.50	.244
2 Hand-fed	1:0.410	.267	1:1.28	.171	1:2.32	.467
3 Hand-fed	1:0.53	.224	1:1.10	.254	1:1.66	.284
4 Hand-fed	1:0.53	.211	1:1.34	.302	1:2.13	.311
5 Self-fed	1:0.427	.176	1:1.76	.260	1:2.63	.407
6 Self-fed	1:0.436	.154	1:2.26	.230	1:4.47	.397
7 Self-fed	1:0.46	.255	1:1.87	.140	1:2.86	.367
8 Self-fed	1:0.50	.210	1:1.79	.165	1:3.53	.355

In arranging this table 33 per cent of the weight of the oats was considered as hull and, therefore, computed as roughage. Likewise, 20 per cent of the weight of the corn-and-cob meal was considered as cob and figured as roughage.

THE BREAKING AND BURSTING STRENGTH OF SOME WEIGHTED AND UNWEIGHTED SILK FABRICS AFTER EXPOSURE TO LIGHT

MARION E. GRIFFITH

One of the factors which affects the durability of fabrics is exposure to sunlight. Many methods have been developed from time to time for testing the sun's effect; the method most commonly used at the present time is that of exposing the fabrics to the light of the violet carbon arc of the "Fadeometer".

A comparison of the effect of the violet carbon arc on the breaking and bursting strength of some pure dye and some weighted white silk fabrics is reported here.

TABLE 1.—Analysis of Silks

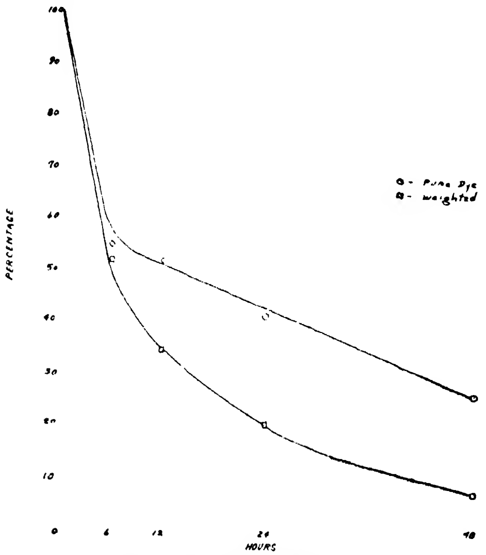
	Unweighted silks					Weighted silks				
	A	B	C	D	E	H	I	J	K	L
Price per sq. yd....	$1.83	$1.78	$2.71	$2.28	$2.32	$2.71	$1.84	$1.49	$1.81	$1.58
Weight in ounces per sq. yd......	1.91	1.88	1.84	1.84	1.85	3.17	2.31	2.38	2.25	2.44
Thickness in inches	0.0058	0.0058	0.0050	0.0048	0.0063	0.0072	0.0056	0.0057	0.0055	0.0058
Yarns per inch:										
(a) warp.......	133	189	130	133	198	141	184	165	179	171
(b) filling......	78	86	95	94	90	83	84	72	78	69
Yarn count: (yds. per lb.)										
(a) warp.......	69,953	108,224	74,426	102,598	109,397	37,837	61,035	58,181	63,636	59,141
(b) filling......	60,817	55,773	64,764	70,937	76,430	49,888	63,546	62,745	58,144	56,034
Per cent shrinkage										
(a) warp.......	2.63	1.84	3.95	*0.52	2.61	2.72	4.46	3.16	2.66	1.84
(b) filling......	*1.55	1.54	0.00	*3.52	*1.54	5.83	5.09	9.05	4.67	3.15
Strength - weight factor..........	124.6	119.4	139.0	113.1	17.4	23.2	52.4	28.2	48.8	27.3
Breaking strength:										
(a) wet										
(1) warp.....	111.8	96.8	139.6	102.0	113.8	102.4	106.6	90.4	185.4	100.8
(2) filling....	60.0	79.2	76.6	77.0	67.6	60.8	54.2	50.4	54.2	45.6
(b) dry										
(1) warp.....	153.6	126.2	161.4	135.4	135.0	50.4	92.2	47.4	86.0	55.3
(2) filling....	85.0	99.4	94.6	73.8	82.6	23.5	29.3	20.1	23.8	11.2
Bursting strength:										
(a) wet........	128.7	127.0	135.8	132.8	116.4	117.8	100.6	89.8	95.4	95.2
(b) dry........	150.0	146.2	157.4	159.6	131.8	61.2	45.6	34.0	49.2	30.3

*Indicates increase in measurement rather than shrinkage.

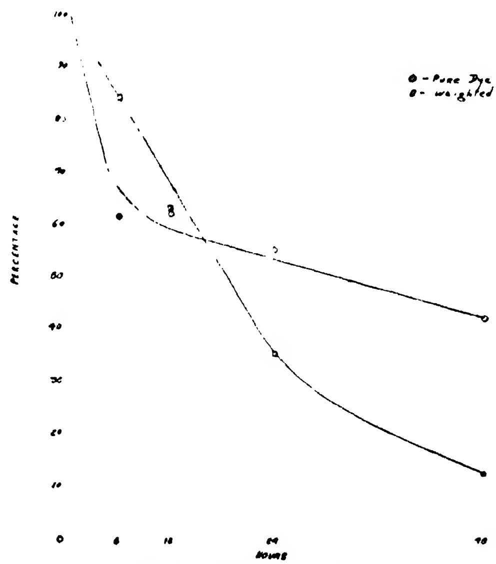
The fabrics included are pure dye silks (A, B, C, D, and E) and weighted silks (H, I, J, K, and L); all the silks are mulberry silks of plain weave and crepe construction. Table 1 gives an analysis of these silks.

Samples of the silks were exposed to the violet carbon arc light for periods of 6, 12, 24, and 48 hours, respectively, and the breaking and bursting strength determined after each period of exposure.

Tests were made of the breaking and bursting strengths of bone dry samples and of wet samples (soaked in distilled water for 5 minutes and drained). The breaking strength was determined by



GRAPH I AVERAGE WET BREAKING STRENGTH

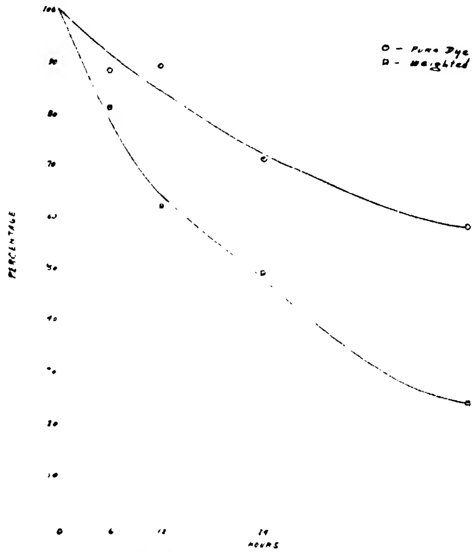


GRAPH II AVERAGE DRY BREAKING STRENGTH

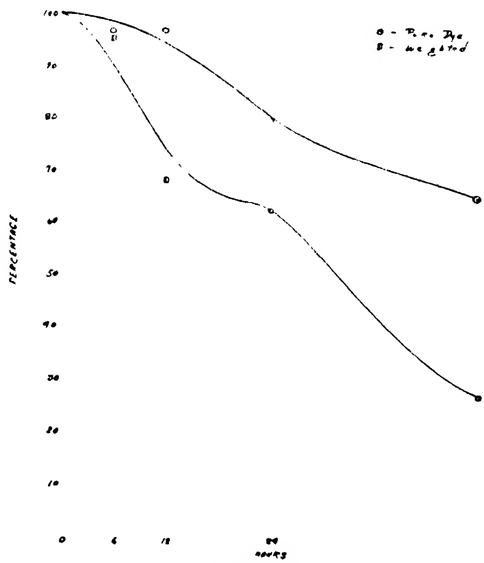
means of a Scott Universal tester by the 1- by 1- by 3-inch grab method. The bursting strength was determined by means of the ball-burst test attachment of the Scott tester. The strength-weight factor was calculated as follows:

$$\text{Strength-weight factor} = \frac{\text{Pounds warp breaking strength} + \text{Pounds filling breaking strength}}{\text{Fabric weight in ounces per square yard}}$$

In Table 2 is given the bursting and breaking strength of the silks before and after exposure to light.



GRAPH III AVERAGE WET BURSTING STRENGTH



GRAPH II AVERAGE DRY BURSTING STRENGTH

Graphs I, II, III, and IV show the percentage change in bursting and breaking strength of the fabrics after exposure to light for periods of 6, 12, 24, and 48 hours, respectively. Some of the results of exposure of silk to light as shown in these graphs are:

1. In all cases there is less change in the strength of the unweighted than in that of the weighted silks.

2. There is less change in bursting than in breaking strength of both weighted and unweighted silks.

3. The change in bursting and breaking strength is quite similar in both weighted and unweighted silks after 6 hours' exposure, but they show a greater difference after longer periods of exposure.

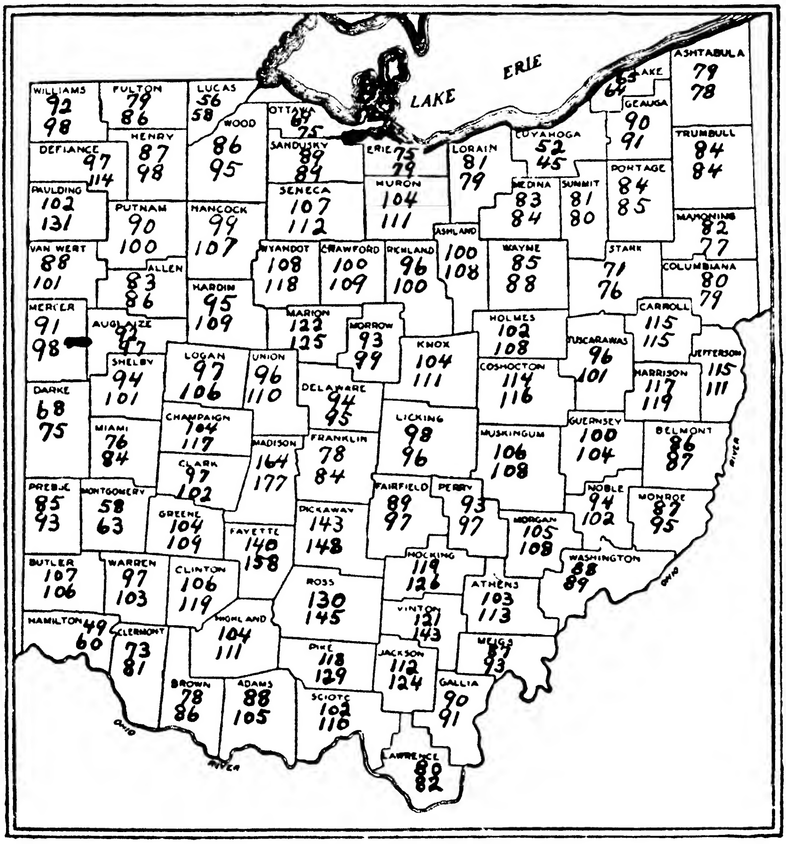
TABLE 2.—Bursting and Breaking Strength in Pounds

Silk	Number of hours exposed	Breaking strength				Bursting strength	
		Wet		Dry		Wet	Dry
		Warp	Filling	Warp	Filling		
Pure Dye:							
A	0	112	60	154	85	129	150
	6	70	38	88	57	111	151
	12	93	37	93	58	107	159
	24	59	23	77	52	90	139
	48	45	15	66	38	87	101
B	0	97	79	126	99	127	146
	6	62	60	76	67	115	157
	12	61	55	74	67	135	140
	24	59	41	73	58	87	105
	48	28	23	63	45	75	81
C	0	140	77	161	95	136	157
	6	92	52	95	58	120	143
	12	90	46	99	66	120	157
	24	73	44	104	65	89	130
	48	44	26	75	47	96	132
D	0	102	77	135	74	133	159
	6	65	54	72	56	103	143
	12	52	48	71	51	108	140
	24	42	35	53	38	97	105
	48	27	20	37	25	39	68
E	0	114	68	135	83	116	132
	6	78	60	76	60	115	128
	12	69	49	82	60	100	122
	24	53	41	71	42	89	111
	48	39	28	60	32	Inc.	Inc.
Weighted:							
H	0	102	61	50	23	118	61
	6	60	36	33	20	79	58
	12	56	19	36	2	69	31
	24	49	1.7	30	0	42	27
	48	11	0	0	0	35	16
I	0	107	54	92	29	101	46
	6	59	26	72	22	79	45
	12	47	4	50	8	42	26
	24	38	11	41	6	39	25
	48	19	0	30	0	20	11
Pure Dye:							
J	0	90	50	47	20	90	34
	6	63	22	56	2	79	42
	12	58	19	47	3	71	38
	24	35	11	25	0	40	33
	48	24	4	23	1	32	17
K	0	185	54	86	24	95	49
	6	82	29	32	36	79	42
	12	47	18	61	31	66	31
	24	25	8	26	22	55	28
	48	2	4	81	4	9	7
L	0	101	46	55	11	95	30
	6	64	18	64	16	75	22
	12	52	8	37	10	55	27
	24	42	7	28	0	61	26
	48	36	0	5	0	20	6

SIZE OF OHIO FARMS

J. I. FALCONER

The Census of 1920 reported the average size of farms in Ohio at 91.6 acres; the Census of 1930 reported 98.2 acres. The number of farms in the State decreased from 256,695 to 219,292. Farms of under 3 acres increased in number, as did also farms of 175 to 259 acres and farms of 260 to 499 acres. There were 728 farms between 500 and 999 acres in 1920 and 792 in 1930. Farms of over 1000 acres decreased from 105 to 104 during the 10 years.



Average size per farm in acres

Upper figure, 1920; Lower figure, 1930

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

Since January the prices of Ohio farm products have been fluctuating around the 1910 to 1914 level. For over a year now the price of commodities purchased by farmers has been declining, although not as fast as that of commodities sold. In March 1931, items purchased showed a price level of 136 and commodities sold an index of 100. Farm wage rates are now at nearly pre-war level; industrial wage rates, however, still remain comparatively high. The wholesale commodity price index used here is based upon the new index of the Bureau of Labor Statistics and shows a figure lower than that of the old index. More commodities have been included.

Trend of Ohio Prices and Wages, 1910-1914=100

	Wholesale prices all commodities U. S.	Weekly earnings N. Y. State factory workers	Prices paid by farmers for commodities bought U. S.	Farm product prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm product prices	Ohio cash income from sales
1913	102	......	100	100	104	100	105	100
1914	99	100	101	102	102	102	105	107
1915	102	101	106	100	103	107	106	110
1916	125	114	123	117	113	113	121	121
1917	172	129	150	176	140	119	182	198
1918	192	160	178	200	175	131	203	243
1919	202	185	205	209	204	135	218	266
1920	225	222	206	205	236	159	212	242
1921	142	203	156	116	164	134	132	136
1922	141	197	152	125	145	124	127	136
1923	147	214	153	135	166	122	134	149
1924	143	218	154	134	165	118	133	150
1925	151	223	159	146	165	110	159	164
1926	146	229	156	136	170	105	155	176
1927	139	231	154	131	173	99	147	163
1928	143	232	156	139	169	96	154	147
1929	141	236	155	138	169	94	151	161
1930	126	226	146	117	154	90	129	128
1929								
January	142	234	156	133	166	......	144	149
February	141	236	156	136	......	......	149	143
March	142	239	156	140	......	94	155	151
April	141	237	155	138	163	......	150	150
May	140	236	155	136	......	......	152	147
June	141	236	155	135	......	......	153	160
July	143	235	154	140	172	......	157	207
August	143	237	154	143	......	......	159	187
September	142	240	154	141	......	......	153	171
October	141	237	154	140	174	......	151	162
November	138	233	154	136	......	......	149	154
December	138	234	154	135	......	......	147	155
1930								
January	136	234	153	134	158	......	141	155
February	135	231	152	131	......	......	137	124
March	133	235	151	126	......	90	132	133
April	132	231	151	127	158	......	136	140
May	130	228	150	124	......	......	132	129
June	127	227	149	123	......	......	131	134
July	123	224	148	111	155	......	123	114
August	123	224	147	108	......	......	125	119
September	123	227	146	111	......	......	129	122
October	121	220	144	106	147	......	125	130
November	117	215	142	103	......	......	122	123
December	114	216	139	97	......	......	112	114
1931								
January	112	212	138	94	133	......	106	111
February	110	215	137	90	......	......	98	87
March	109	219	136	91	......	82	100	97
April	107	215	134	91	119	......	103	98
May	......	......	131	86	......	......	98	92

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[1]In cooperation with College of Agriculture, Ohio State University.
[2]In cooperation with the U. S. Department of Agriculture.

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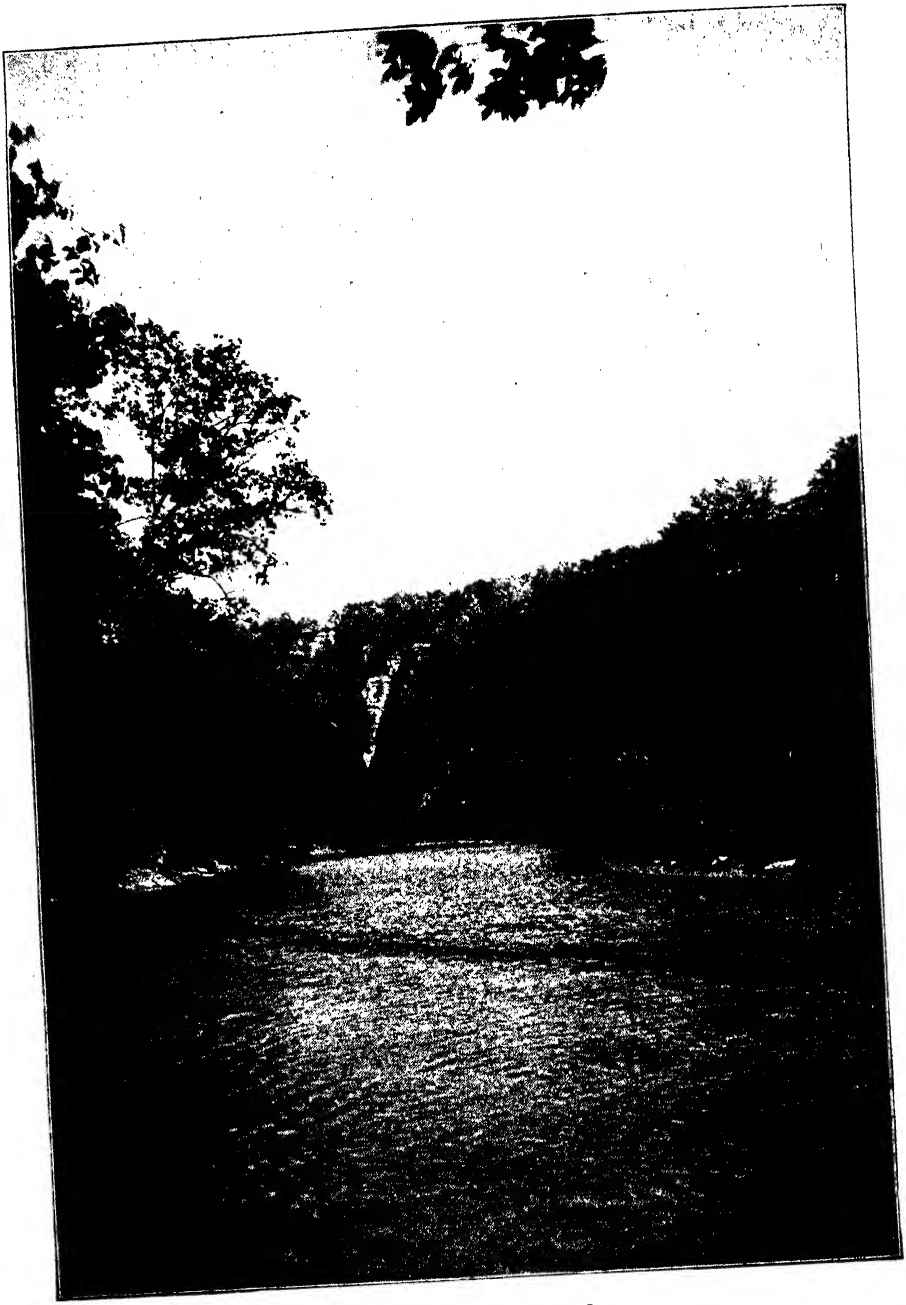
Director



Mohican Forest Park

THE INTENSIVE MANAGEMENT OF PERMANENT PASTURE IN DAIRY FARMING[1]

ROBT. M. SALTER AND R. E. YODER

An intensive system of pasture fertilization and management has been extensively adopted by European farmers during the past decade. Although introduced in Germany by Falke nearly 30 years ago, this system is usually referred to as the *"Hohenheim"* system, doubtless because of its having been thoroughly investigated by Professor Warmbold at Hohenheim, Germany, about 1916. In brief, the system consists of dividing a permanent pasture into small fields or paddocks which are fertilized and grazed in rotation. In order to determine the merits of the system under Ohio conditions, an experiment has been carried on for the last 2 years on the Schaaf Dairy Farm near Columbus.

A good, 30-acre, blue grass pasture was divided into smaller areas, three 6-acre paddocks and three 4-acre paddocks being formed. A basic fertilizer treatment of 500 pounds of superphosphate (20% P_2O_5) and 120 pounds of muriate of potash per acre were applied to the entire pasture area, with the exception of small test plot areas in each of the paddocks, in October 1928. This basic treatment was assumed to be adequate for 3 years. The soil was neutral in reaction; hence, it was not deemed necessary to apply any liming material. Four applications[2] of Arcadian sulfate of ammonia (20.5% nitrogen) totalling 500 pounds per acre have been applied each year at approximately the following dates:

March 15th to April	5th—150	pounds sulfate of ammonia per acre
June 1st to June	20th—150	pounds sulfate of ammonia per acre
July 1st to July	20th—100	pounds sulfate of ammonia per acre
August 1st to August	20th—100	pounds sulfate of ammonia per acre

All fertilizer materials are broadcasted with a lime or fertilizer spreader. Test plot areas are fertilized by hand on the same day that the paddocks are treated.

The herd used, consisting of 60 to 70 head of pure-bred Holsteins and Guernseys, is a high-producing one with an average butterfat production of 362 pounds per cow in 1930. Such a herd is very sensitive to changes in feed supply. Concentrates, hay, and silage are used throughout the grazing season to supplement the pasture herbage.

[1]A progress report of investigations carried on under a fellowship supported by the Barrett Company, New York.

[2]July top dressing of sulfate of ammonia omitted in 1930 because of a lack of rainfall.

The aim has been to turn the herd into a paddock when the grass is from 4 inches to 6 inches high. As soon as manger feed consumption and milk production indicate that there is a shortage of available pasture herbage, the herd is shifted to a fresh paddock. It has been found to be good practice to use two paddocks at the same time when the supply of herbage is low. The fresher paddock is used for the short, day, grazing period and the older, more trampled one for the longer, night, grazing period. This equalizes the amount of feed the cattle receive each day from the pasture and makes it easier to maintain a constant milk flow with additional manger feeding. At the same time, the cows eat the trampled grass on the older paddock better at night when it is moist with dew. Young stock which are not receiving manger feed may be used to clean up the grass that is not eaten by the main herd. Unfortunately, through no fault of the system, however, such a group of stock was not available on the Schaaf Farm except for a short period during the spring of 1929.

Harrowing to spread the dung piles has been found to be one of the important operations in the management of the pasture. This practice prevents the appearance of tufted or ungrazed areas, thereby materially increasing the grazing area of the paddocks. Two or three harrowings per year are believed to be sufficient in a normal season. Harrowing is best done at a time when the moisture content of dung is such that it pulverizes well and yet does not smear up the grass. When possible the plots are not grazed following the harrowing operation until the grass has been washed off by rain. A flexible chain harrow of German design was found to be more efficient than a common peg tooth or drag harrow.

The pasture area is mowed once or twice a year for weed control and to remove mature, unpalatable grass. The cutting off of the mature grass promotes new leaf growth.

CARRYING CAPACITY

The carrying capacity of the pasture previous to experimental treatment was estimated at 1¼ to 1½ acres per cow or from 0.66 to 0.80 cows per acre. Tables 1 and 2 summarize the carrying capacity of the pasture under the intensive system of management.

Table 1 shows that the carrying capacity of the pasture was more than doubled in 1929. Even in a season of extreme drouth, as in 1930, as indicated by the data in Table 2, the total seasonal production of the pasture measured in cow days of grazing was slightly greater than that of a normal year without fertilization.

TABLE 1.—Carrying Capacity in Cow Days by Paddocks—1929

Month	Paddock Number I	II	III	IV	V	VI	Total
April	244.5	....	....	....	....	....	....
May	183.5	301.5	336.5	510.0	664.0	....	1986.5
June	340.0	499.5	302.5	505.5	268.5	524.0	2440.0
July	209.0	165.5	268.0	297.0	195.0	196.5	1331.0
August	58.0	133.5	154.5	202.0	165.5	163.5	887.0
September	301.5	125.0	123.5	246.5	243.0	273.0	1312.5
October	88.0	22.0	108.0	215.5	396.0	437.0	1266.5
Totals	1424.5	1247.0	1293.0	1967.5	1932.0	1594.0	9468.0

$$\frac{9468}{173 \times 30} = 1.82 \text{ cows per acre for 173 days.}$$

Small test plots located in each paddock are used to determine the actual production of the pasture. Three of these plots are located on each paddock, one plot being unfertilized, one receiving only the basic PK treatment, and one the complete treatment given the entire paddock. The herbage on these plots is harvested with a lawn mower, equipped with a grass catcher, immediately before turning the cattle into the paddock. The test plots are open to the cattle and are harrowed along with the balance of the pasture. The samples obtained from these plots are dried and used, along with a composite of five samples taken at random over the paddock, for yield determinations and for chemical analysis.

In Figure 1 is presented graphically the crude protein content of the pasture herbage for 1929 summarized by months. The total production of dry matter for each year by paddocks is given in Table 3, and similar data for crude protein in Table 4.

TABLE 2.—Carrying Capacity in Cow Days by Paddocks—1930

Month	Paddock Number I	II*	III	IV	V	VI	Total
April	138.0	103.5	137.0	274.0	101.5	....	754.0
May	213.0	90.5	204.0	257.5	374.5	442.0	1590.5
June	....	....	....	26.0	58.5	71.5	156.0
July	....	....	....	....	....	....	0.0
August	....	....	....	....	....	....	0.0
September	315.0	445.5	324.5	241.0	....	59.0	1385.0
October	90.0	90.0	59.0	108.0	420.0	404.5	1171.5
Totals	756.0	738.5	724.5	906.5	954.5	977.0	5057.0

*Paddock II did not receive any nitrogen top dressings in 1930. This paddock was not grazed as closely in May as were the other paddocks because the grass was less palatable. The bluegrass sod on this paddock was not injured by the drouth as seriously as was that of the other paddocks, which probably accounts for its superior productivity in September.

$$\frac{5057}{184 \times 30} = 0.92 \text{ cows per day for 184 days.}$$

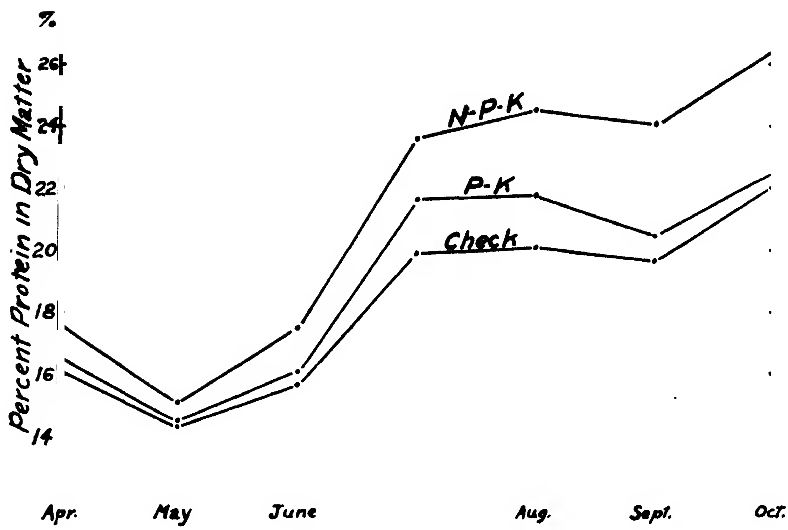


Fig. 1.—Graph showing the influence of fertilizer treatment on the protein content of the pasture herbage in 1929

From Tables 3 and 4 it may be assumed that 40 per cent of the total dry matter and 51 per cent of the total protein produced on the entire pasture in 1929 was due to fertilization. Likewise, 65 per cent of the dry matter and 71 per cent of the protein produced in 1930 are credited to fertilization.

TABLE 3.—Dry Matter Production per Acre by Paddocks

Paddock No.	Fertilizer treatment†							
	Check		P-K		N-P-K		Field	
	1929	1930	1929	1930	1929	1930	1929	1930
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
I................	1627	312	2082	534	3780	1098	4227	1222
II*...............	1809	454	1968	785	3276	1001	3342	1015
III...............	2218	499	2468	785	4657	1534	4213	1472
IV................	1929	437	2201	578	3324	1306	3833	1214
V.................	3591	675	2538	1010	3715	1820	3948	1632
VI................	3352	780	4454	1019	5716	1755	5874	1741
Average.........	2421	521	2618	785	4045	1503	4239	1456

*Paddock II did not receive any nitrogen in 1930; 1930 data on this area not included in averages.

†Check = No fertilizer treatment.
P-K = Phosphorus-potash fertilization.
N-P-K = Nitrogen-phosphorus-potash fertilization.
Field = Average of 5 samples taken at random over the paddock.

TABLE 4.—Protein Production per Acre by Paddocks

Paddock No.	Fertilizer treatment†							
	Check		P-K		N-P-K		Field	
	1929	1930	1929	1930	1929	1930	1929	1930
	Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
I	302.1	55.4	383.3	112.1	768.4	254.1	829.8	289.0
II*	320.3	37.7	362.5	163.2	649.7	219.0	665.2	226.8
III	372.5	91.6	464.9	158.5	882.8	356.4	817.0	343.5
IV	316.5	74.7	375.1	123.0	669.5	316.0	748.7	296.7
V	550.5	125.9	406.3	201.7	674.8	428.1	835.0	378.7
VI	478.2	165.1	753.0	229.8	1003.0	439.8	1140.0	422.8
Average	390.0	102.5	457.5	165.0	789.7	358.9	839.3	346.1

*Paddock II did not receive any nitrogen in 1930; 1930 data on this area not included in averages.

†Check = No fertilizer treatment.
P-K = Phosphorus-potash fertilization.
N-P-K = Nitrogen-phosphorus-potash fertilization.
Field = Average of 5 samples taken at random over the paddock.

	1929	1930
	Lb.	Lb.
Increase of P-K over the check	67.5	62.5
Increase of N-P-K over check	399 7	256.4
Increase of N-P-K over P-K	332.2	194.9

In order to evaluate the increased production of pasture herbage as brought about by fertilization, complete records of manger feed consumption are kept during the grazing season including those periods during which there is no pasture available. From these supplementary feed records it is possible to estimate rather closely the production of the pasture in terms of manger feed replaced by pasture herbage.

TABLE 5.—Value of Pasture Herbage in Terms of Manger Feed Replaced*

Year	April	May	June	July	Aug.	Sept.	Oct.	Total
	Dol.	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*	*Dol.*
1929	65.75	552.25	778.25	371.25	253.75	284.25	200.00	2505.50
1930	178.09	361.00	17.50	0.00	0.00	225.75	100.75	883.00

*Western alfalfa hay at $28.00 per ton.
Concentrates (av.) at 37.50 per ton.
Corn silage at 7.00 per ton.

In Figures 2 and 3 is shown graphically the estimated saving in manger feed for fertilized and unfertilized pasture, respectively, for 1929 and 1930.

One hundred pounds of nitrogen were applied per acre in 1929. Fifty-three per cent of this amount was recovered in 1929, and 9 per cent of the 1929 application was recovered in 1930. Eighty pounds of nitrogen were applied in 1930 and because of the drouth period, only 27 per cent of this amount was recovered.

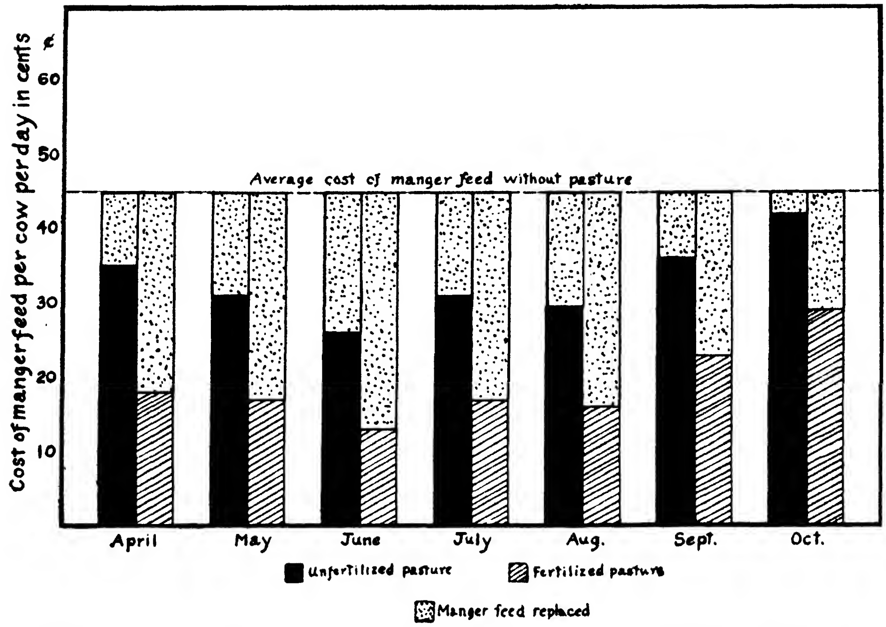


Fig. 2.—Chart showing the influence of fertilization of pasture upon the cost of manger feed consumed per cow per day in 1929

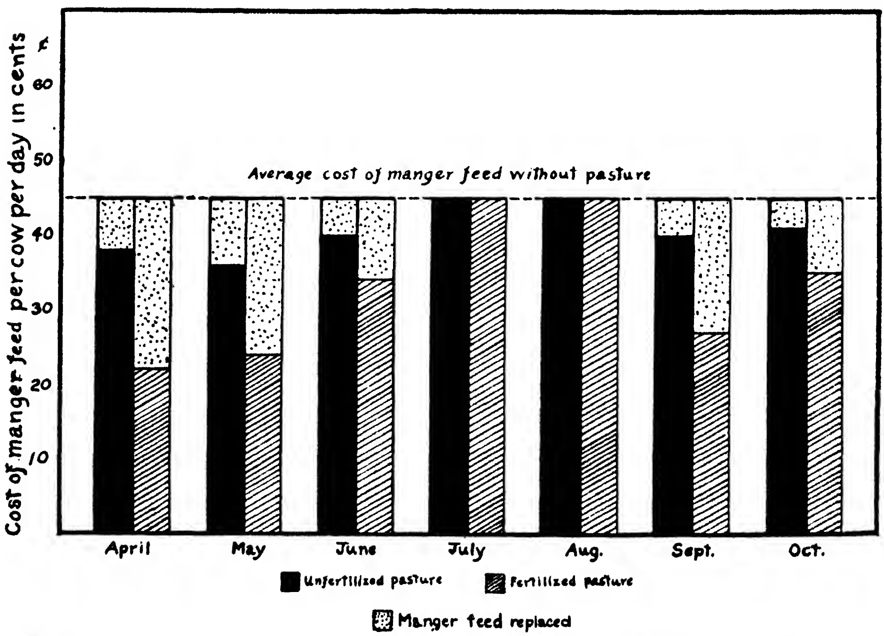


Fig. 3.—Chart showing the influence of fertilization of pasture upon the cost of manger feed consumed per cow per day in 1930

TABLE 6.—Cost of the System of Management

	30 acres 1929	16 acres 1930	4 acres no nitrogen 1930
	Dollars	*Dollars*	*Dollars*
Fencing (10-yr. life)	$20.35	$17.68	$2.72
Water system (8-year life)	29.87	25.89	3.98
Phosphorus-Potash (3-yr. life)	111.89	96.98	14.92
Sulfate of Ammonia	397.50	273.00	....
Harrowing	84.00	26.00	4.00
Mowing	16.80	....	2.00
Total	660.41	439.55	27.62
Cost per acre	22.01	16.90	6.90

Labor figured at $0.50 per acre per operation. Sulfate of ammonia valued at $45.00 per

TABLE 7.—Data Showing the Financial Returns from the Intensive System

	On basis of dry matter		On basis of protein	
	1929	1930	1929	1930
	Dollars	*Dollars*	*Dollars*	*Dollars*
Value of herbage produced by fertilization	1002.25	574.00	1277.75	627.00
Cost of fertilizer (applied)	509.39	384.90	509.39	384.90
Returns above fertilizer cost	492.86	189.10	768.36	242.10
Total expenditures	660.41	467.17	660.41	467.17
Net returns	341.84	106.83	617.34	159.83
Net returns per acre	11.39	3.56	20.58	5.33
Net returns per dollar invested in fertilizer	0.67	0.28	1.21	0.41
Net returns per dollar expended	0.52	0.23	0.93	0.34

From Tables 6 and 7 it may be concluded that it has been considerably more profitable to produce both protein and dry matter through fertilization of the pasture than to buy these materials in the form of commercial feeds at the prices obtaining during the 2-year period.

ADVANTAGES AND DISADVANTAGES OF THE SYSTEM

Two years' experience with the system appear to indicate the following advantages: (1) a lengthening of the grazing season by about 3 weeks, (2) an increase in protein content of the herbage and in total production of both protein and dry matter, (3) an increased carrying capacity per acre with corresponding decrease in grazing area required, (4) a reduced manger feed consumption, and (5) an increased density of turf. Disadvantages inherent in the system are: (1) a relatively high acre cost, (2) the need for skillful grazing management, and (3) the difficulty in maintaining white clover in the herbage.

It appears that rainfall is of considerable importance in determining the utilization of the fertilizer applied. Although the fertilizer treatment apparently reduces the need for supplementary pasture during periods of midsummer drouth, it by no means eliminates this need.

Factors which may be expected to determine the extent of the adoption of the intensive system on dairy farms in this area are: (1) the market price of nitrogenous fertilizers, (2) the acreage of pasture available on the farm and its acre value, (3) the productive capacity of the herd, and (4) the degree of response of the soil to fertilizer treatment.

SUGGESTIONS AS TO ADOPTION OF THE SYSTEM

Further work is needed before definite recommendations can be made as to the economy of the intensive system of pasture management in Ohio. However, with the declining price of nitrogenous fertilizers, it seems reasonable to expect that more and more livestock farmers may find it profitable to produce a larger portion of their feed from permanent pasture through liberal fertilization. For the dairyman who is operating on high priced land and who has only a limited area of permanent pasture available, a system which offers the possibility of doubling its carrying capacity at reasonable cost appears worthy of trial. For those who may wish to do so the following suggestions are offered.

If the soil is fairly acid (below pH 5.5), an initial application of lime is probably advisable. A basic treatment of fertilizer containing both phosphoric acid and potash sufficient for a 3- or 4-year period is also desirable. From 300 to 500 pounds per acre of an 0-14-6 fertilizer, applied either in the fall or early spring, are suggested.

In dividing the pasture into paddocks, the size of paddocks should be determined by the size of the herd. Not more than six or eight animal units should be placed on one acre. Thus, four-acre paddocks would be satisfactory for about a 30-cow herd.

Three applications of a quickly available inorganic nitrogen fertilizer are suggested. The first top dressing should be made in the early spring around the last of March or first half of April. An application of 100 to 150 pounds of sulfate of ammonia per acre, or of the equivalent amount of other suitable nitrogen carrier, at this time will provide early spring grazing. This may be followed by similar applications in June and August.

The pastures should be mowed once or twice a year to prevent any weeds present from going to seed. Harrowing to scatter dung piles will be found to be beneficial in promoting an even growth over the entire pasture and in preventing the appearance of ungrazed or tufted areas around old dung heaps.

In the division of the permanent pasture into smaller fields care should be taken to provide shade and drinking water in each of the areas.

The herd should be turned into the pasture when the grass is 3 or 4 inches high and shifted to a new field after the herbage has been grazed off. With four to six small fields fertilized and grazed in rotation, a rather constant supply of herbage is provided during a normal season with the exception of a period of hot, dry weather which usually occurs in July and August in Ohio.

THE WHEAT FIELD SURVEY—1931

J. S. HOUSER

Annually, at the time wheat is ripening, the entomologists of Ohio perform a special service for the wheat growers of the State by taking a census of the status of the Hessian fly and other wheat pests. As is well known, the abundance of insects varies from year to year, and in the case of the Hessian fly it is of considerable value to determine the status of the insect preceding the seeding of the new crop, since such information may be utilized in avoiding losses the year following. Moreover, the value of the data is increased if it is compared with that obtained the preceding year.

In 1930 it was found that the average infestation for the State, as calculated from the data obtained in the 20 counties surveyed, was only 6.8 per cent which, in turn, was a slight increase over the 4.6 per cent state-wide infestation of 1929. This year, the average infestation for the State, based on the data obtained from the 19 counties surveyed, was 12.2 per cent, or nearly double that of 1930. This increase is interpreted as being quite significant, since it indicates that the Hessian fly in Ohio is in process of building up and, if not arrested by the proper adherence to the fly-free seeding dates, may increase to epidemic proportions.

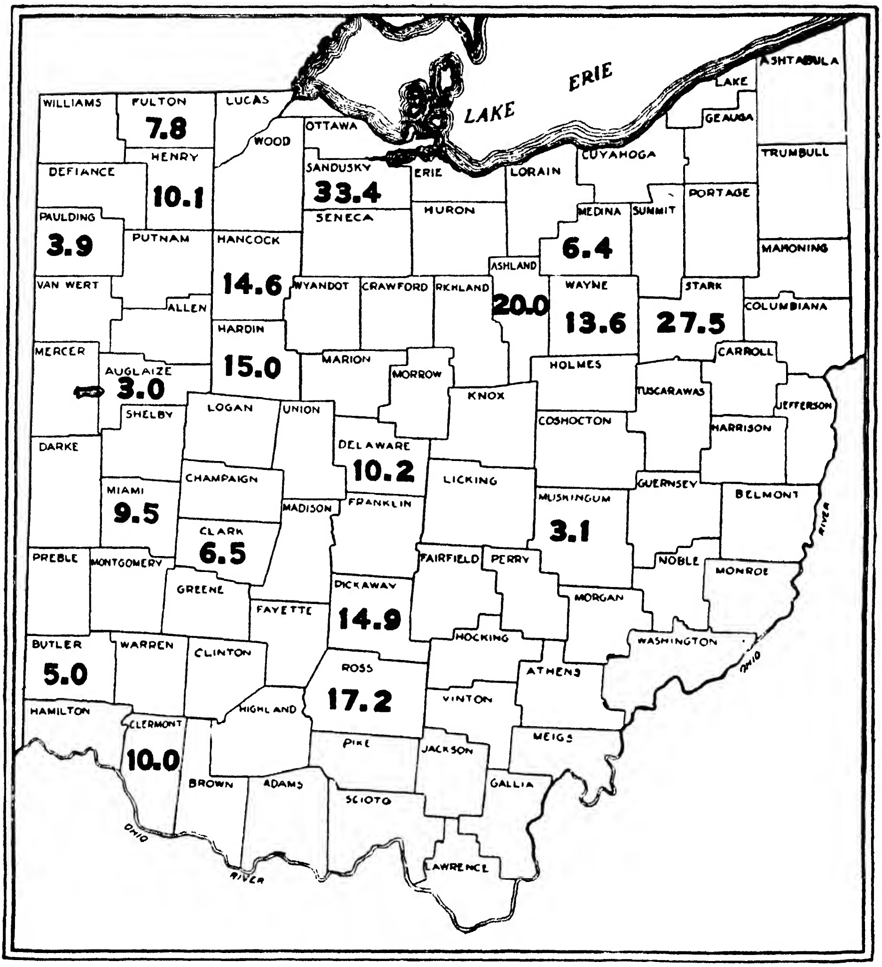


Fig. 1.—The figures indicate the percentage of wheat infested with Hessian fly in the counties surveyed

The 1930 survey showed that the only area in the State where the fly was present in sufficient numbers to constitute a menace to the succeeding crop was in the extreme southwestern section where the fields in Butler County carried an average infestation of 34 per cent; Miami and Warren, 10 per cent; Clermont, 11 per cent; and Highland, 13 per cent. As a consequence, it was suggested that the farmers in that area adhere closely to the proper seeding date. It is gratifying to note that, in general at least, cognizance of the warning was taken, for this year Butler County has dropped to a 5 per cent infestation, Miami to 9.5 per cent, and Clermont to 10 per

cent. As will be noted on the accompanying map showing the location of the counties surveyed this year and the percentage of fly-infested wheat found in each county, the general infestation of Sandusky County, 33.4 per cent, was the highest found in the State and that of Stark County, with an average of 27.5 per cent, was also high. Of greater significance, however, is the fact that groups of counties in northeastern, northwestern, and south central Ohio carry infestations of significant importance.

In evaluating a situation with respect to the fly, such as exists this year, not only should we consider the percentage of infestation found, but also the volume of the straw grown. If the straw is light and the stand very thin, an average infestation of 12 per cent would mean that the total volume of fly in a particular area was not great. On the other hand, if the crop is very heavy with a thick stand of plants (such as Ohio has this year), a 12 per cent infestation would mean that the total number of flies in a given field is much greater. It must be borne in mind that the greater the number of Hessian fly flax seeds remaining in the cut stubble, the greater will be the swarm of flies visiting and laying their eggs on the new crop this fall—if the new crop is up when the flies emerge. To regulate the date of seeding so that the flies will emerge before the fall wheat comes up and thus perish without doing damage is the principle on which rests the fly-free seeding date. It is of almost equal importance, however, that the seedbed be well prepared in order that the wheat be given every advantage to grow rapidly after it comes up. A good stand of high vigor is less likely to winter kill than is a weak, poor stand; thus, the use of fertilizers in the fall is considered helpful in the program of avoiding Hessian fly damage.

Another factor which should be borne in mind is that, because of the lack of profit in wheat this year, reduction in acreage is likely to result. If the acreage is reduced, concentration of the fall brood is likely to occur, particularly if the wheat is sown early.

Regardless of the sharp increase in abundance of fly, the entomologists making the wheat field survey found very few fields in which actual damage was outstanding. Unquestionably, the excellent stand of robust, vigorous plants, which, in general, characterizes the 1931 crop, accounts in some measure for the failure of the surveyors this season to find fields with large numbers of broken straws and evidence of other serious damage.

The wheat joint worm, while present in the majority of the counties surveyed, was not abundant in any. The greatest numbers were found in Paulding County, where 6.9 per cent of the straws

examined were infested. The wheat sheath worm, which is also called a joint worm, was present in but a few of the counties. Only a trace of wheat midge was found, but chinch bugs were observed in a considerable number of fields.

Although the wheat field survey is primarily for the purpose of determining the status of wheat insects, the entomologists record notes on such other insects as may be observed. This year the following insects seemed to be unusually abundant: cutworms, sod webworms, army worms, Colorado potato beetles, and flea beetles on potatoes. Chinch bugs were more numerous than at any time for several years.

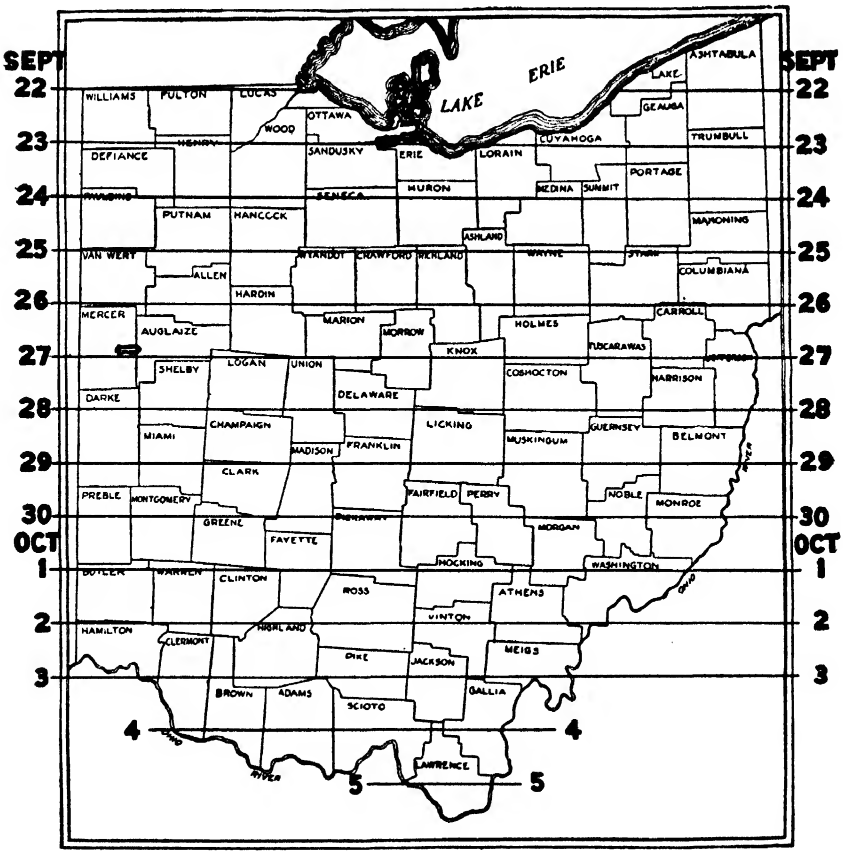


Fig. 2.—Hessian fly-free seeding dates

RECOMMENDATIONS FOR 1931 SEEDING

In view of the sharp increase in the abundance of the Hessian fly, it is the consensus of opinion of the entomologists that the seeding dates suggested on the map accompanying this article should be carefully adhered to. As previously suggested, care in providing a good seedbed is also of utmost importance and, if possible, commercial fertilizer should be used, particularly on poor soil.

According to the agronomists, wheat requires a firm, well settled seedbed, free from clods. This can be secured most easily by early plowing and by harrowing the soil following each rain. Two or three hundred pounds per acre of fertilizer, analyzing 2-14-4, always aid materially in stimulating growth in the fall. The agronomists further state that wheat which has made a weak fall growth may be safeguarded in considerable measure against winter killing by a top dressing of manure.

CONTROL OF "DAMPING-OFF" OF FLOWER SEEDLINGS

PAUL E. TILFORD

Practically all flower seedlings which are started in plant beds or in flats are subject to "damping-off". The small plants rot off near the surface of the soil and fall over. Sometimes they do not completely damp-off and collapse, but are stunted, due to a part of their roots being infected. Such plants never make satisfactory transplants. In still another form of damping-off the young sprout is destroyed as soon as it emerges from the seed, and in this case no plant at all is produced.

Damping-off is caused by several common soil fungi. These parasitic organisms are found to some extent in practically all unsterilized soils and they are able to infect most young, succulent seedlings growing under the crowded, damp conditions in a plant bed or seedling flat.

Sterilizing the soil by steaming, using a soil mixture which drains well but has a high water-holding capacity so that frequent watering is not necessary, ventilating, putting a thin layer of sand over the top of the soil, being careful never to over-water, treating the seed, and watering with weak, disinfecting solutions are practices commonly used by florists to prevent damping-off. Their success is variable. Frequently, in the case of a plant which damps-off badly, such as kochia, a whole flat of plants is destroyed. The most

effective control, so far, has been the proper handling of a correct, sterilized soil mixture. Growers, however, will not usually take the trouble to steam sterilize the soil for seedling flats.

Tests have been conducted at the Experiment Station, endeavoring to obtain a satisfactory control for damping-off of flower seedlings. The results of these experiments are discussed on the following pages.

SEED TREATMENT TESTS

During the spring of 1930 seed was obtained of a large number of flower plants. One hundred seeds of each were treated in a .25 per cent liquid Semesan solution (normal strength) for the recommended length of time. The seeds were then planted in a propagating medium of ½ sand and ½ peat moss. Also, 100 untreated seeds of each kind were planted as a check. The treated and the untreated rows were adjacent to each other; so, in every case, each had an equal chance. As soon as the plants were large enough to transplant, counts were made of the good plants, Table 1.

TABLE 1.—Control of Damping-off by Treating Seed in Semesan

Kind of plant	Seed treated in normal Semesan solution		Check, no treatment
	No. of minutes soaked	No. of plants from 100 seeds	No. of plants from 100 seeds
Zinnia	60	76	37
Four O'clock	60	62	46
Calendula	60	49	52
Hollyhock	30	26	19
Centaurea	30	67	10
Scabiosa	30	36	42
Dianthus	60	77	60
Marigold	60	68	39
Candytuft	30	78	56
Hibiscus	90	69	62
Sweet William	30	65	57
Amaranthus	30	73	51
Nasturtium	30	67	56
Verbena	30	22	18
Ageratum	60	45	37
Pansy	30	20	5
Gaillardia	15	10	18
Coreopsis	30	25	20
Heliotrope	60	30	20

In a second experiment, Semesan used as a dry, dust seed treatment was compared with liquid Semesan. Two hundred seeds of six different plants were treated by shaking a small amount of Semesan with the seeds in an envelope. The excess dust was removed before planting. A like number of seeds of each plant was also treated in normal liquid Semesan. These were planted in

a half and half mixture of peat moss and sand. Two hundred untreated seeds were also planted as a check. Counts were made later of the good plants, Table 2.

TABLE 2.—Semesan Dust Treatment vs. Liquid Semesan

Kind of plant	Dry Semesan	Liquid Semesan	Check
	No. of plants from 200 seeds	No. of plants from 200 seeds	No. of plants from 200 seeds
Sweet Alyssum	110	58	44
Heliotrope	49	21	53
Ageratum	41	77	69
Dwarf Snapdragon	17	8	57
Phelps White Snapdragon	83	21	118
Larkspur	72	56	30

Lots of seed of 14 varieties of asters were treated in bichloride of mercury and in Semesan solutions. The seeds treated in bichloride were soaked in water for one hour, kept moist for 5 hours, and then treated in a 1-1000 bichloride of mercury solution for 10 minutes. The seed treated in Semesan was soaked in a normal solution for one hour. An untreated sample of seed was included from each variety for a check, and all were planted in sand and peat moss. Counts were later made of the plants produced, and the percentage of seeds planted which produced good plants calculated. The average percentages for the 14 varieties are as follows: check 44.9, bichloride of mercury treatment 38.5, and Semesan 64.2.

Discussion.—The control of damping-off by treating the seed with Semesan has been variable. Twenty-four varieties of plants have been used in the experiments, and inspection of the results given in the tables shows that 11 have been benefited, 11 neither benefited nor injured, and at least 1, and possibly 2, injured by treating the seed with Semesan. Treating Snapdragon seed resulted in serious injury. The most outstanding benefits were obtained with Asters. In practically every instance much better stands of aster seedlings were obtained when the seed had been treated with Semesan; however, just the opposite was true when the bichloride treatment was used.

When the dry dust and the liquid Semesan treatments were compared (Table 2), the dust appeared to be more desirable in all cases except one. A much better stand of Ageratum was obtained when the seed was treated with liquid Semesan than with the dry dust.

In most cases, except where injury occurs, a high percentage of seeds treated with Semesan produce plants which get through the soil. These plants, later, are just as susceptible to damping-off as though the seed had not been treated. Semesan treatment protects the young sprout only until it gets through the ground and, as a general treatment for the control of damping-off in flower seedling flats, is not satisfactory.

FORMALDEHYDE DUST TREATMENT

During the winter of 1930 and 1931, L. J. Alexander, of the Department of Plant Pathology, at the Ohio Station, was working on the control of damping-off of vegetable seedlings. It was his work, which will be published later, that suggested to the writer the possibility of using formaldehyde dust in the soil to prevent damping-off of flower seedlings.

Formaldehyde dust is prepared by mixing commercial formalin with some carrier having a high adsorbing capacity. Infusorial earth, mixtures of infusorial earth and kaolin, dried muck, and mixtures of muck and the other two materials mentioned have been used and found to be satisfactory carriers. The dust is made to contain 6 per cent formaldehyde, by taking 85 parts by weight of carrier to 15 parts of commercial formalin (40 per cent formaldehyde).

TABLE 3.—Effect of Soil and Seed Treatment on Damping-off

Kind of plant	Per cent of good plants produced in untreated soil		Per cent of good plants produced in soil treated with Formaldehyde dust	
	Seed not treated	Seed treated with Semesan	Seed not treated	Seed treated with Semesan
Zinnia	41	59	85	88
Marigold	68	83	83	81
Calendula	35	40	75	49
Mignonette	7	21	59	51
Cynoglossum	68	65	80	77
Scabiosa	24	31	58	59
Clarkia	13	32	78	78
Kochia	0	22	41	18
Verbena	35	29	47	38
Snapdragon	50	43	78	44
Larkspur	42	41	62	60

Ordinary greenhouse flats of about 2 square feet in area were divided by placing a board crosswise through the middle of the flat. One side of the flats was filled with a mixture of 1/3 sand, 1/3 soil, and 1/3 peat moss; the other side was filled with the same mixture in which 1½ ounces of the 6 per cent formaldehyde dust had been thoroughly mixed. Eight rows of 100 seeds were planted across

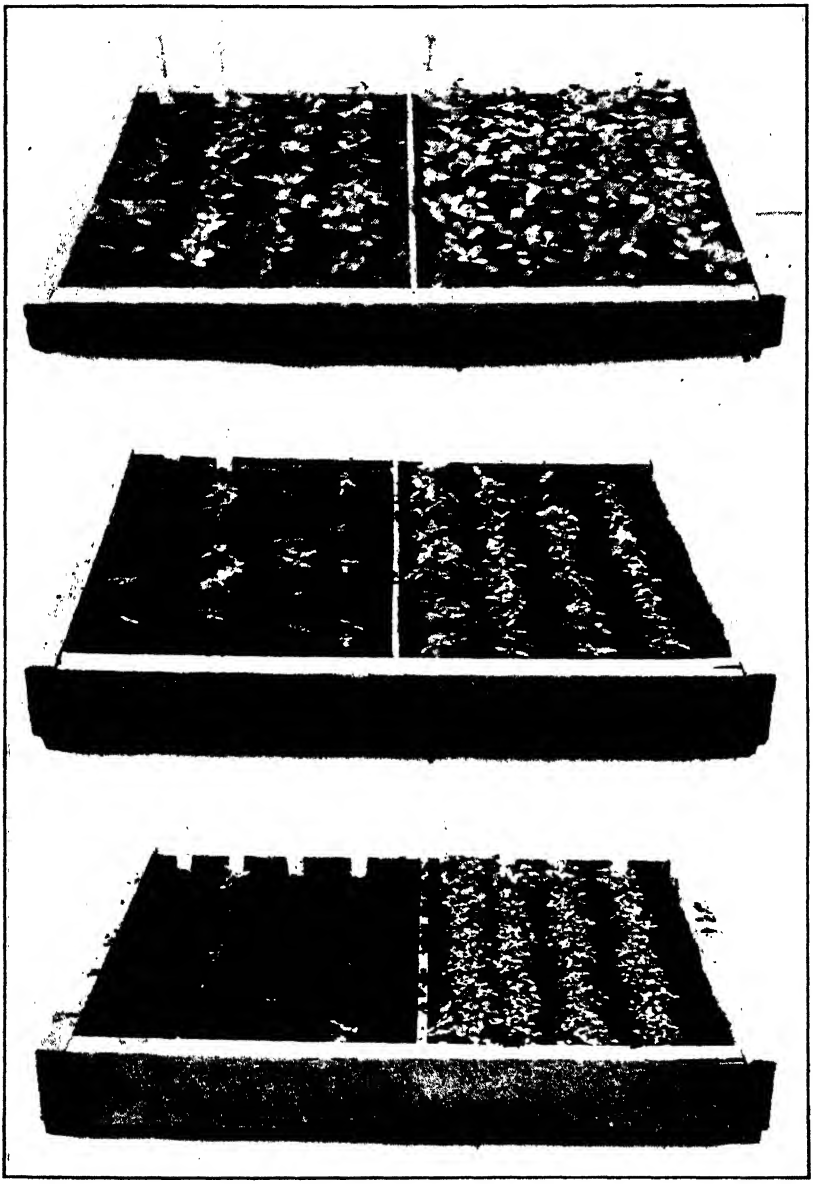


Fig. 1.—Soil not treated in the left half of each flat; right half treated with formaldehyde dust. Zinnia at top; Clarkia in center; Godetia at bottom. 1st, 3rd, 5th, and 7th rows—seed not treated. 2nd, 4th, 6th, and 8th rows—seed dusted with Semesan.

the flat. The seed used in every other row was dusted with Semesan before planting. This gave two rows of 100 untreated seeds in both untreated and treated soil, and 2 rows of 100 Semesan-treated seeds in both untreated and treated soil. As soon as the plants were large enough to transplant, counts of the good plants were made, and the results are given in Table 3.

A better stand of plants was obtained in every flat in the side where the soil mixture was treated with the dust (Fig. 1). A much higher percentage of plants got through the soil because the young sprouts were not rotted off when they emerged from the seed and the plants did not damp-off after they were up. Also, the plants growing in the formaldehyde dust treated soil were generally larger and more thrifty than the best plants in the untreated soil. This, undoubtedly, was due to the fact that the treated soil was free from pathogenic organisms which might injure the young roots.

A very striking thing which showed up in this set of experiments was the stunting effects on some plants which follows treating the seed with Semesan. When the seed was treated and planted in untreated soil a fairly good stand of plants was obtained, practically always a better stand than where the seed was left untreated. After these plants were up, however, they damped-off just as badly as though the seed had never been treated. This would seem to indicate that Semesan is a good seed disinfectant and that if the treated seed was planted in sterilized soil, excellent results would be obtained. When Semesan-treated seed was planted in soil treated with the formaldehyde dust the plants came up but were stunted and much slower in growing than untreated seed planted in the same soil (Fig. 2). That this retarding effect was due to the Semesan alone, and not to the combined effects of Semesan and formaldehyde, is shown by the fact that the plants from treated seed did not grow any better in the untreated soil than they did in the treated (Fig. 2).

This stunting effect of Semesan was noted on the following plants: clarkia, godetia, salpiglosis, calliopsis, mignonette, cynoglossum, and snapdragon. The other plants used did not seem to be much affected by the treatment.

A second test, in which duplicate samples of 100 seeds each were planted in an untreated and in a formaldehyde dust treated, propagating mixture of ½ sand and ½ peat moss, was made. Counts were taken of the good plants and are given in Table 4. Again, a much better stand of plants was obtained in the soil treated with the dust.

TABLE 4.—Control of Damping-off by Formaldehyde Dust

Kind of plant	Good plants produced by 100 seeds planted in untreated medium*		Good plants produced by 100 seeds planted in a formaldehyde dust treated medium*	
	Row 1	Row 2	Row 1	Row 2
Scabiosa	0	6	33	38
Zinnia	61	48	85	85
Clarkia	40	42	68	70
Kochia	12	13	45	55
Marigold	61	71	81	79
Calendula	43	29	63	59
Mignonette	4	0	55	55
Salpiglosis	7	47	80	60
Calliopsis	22	35	66	56
Snapdragon	34	52	47	56
Verbena	17	3	35	39

* ½ sand, ½ peat moss.

Other experiments, which cannot be reported because of lack of space, substantiate the results given. Formaldehyde dust, when properly used, proved to be an excellent control of damping-off. The young sprouts, when they emerge from the seed, are protected, a good stand of seedlings is obtained, and the seedlings do not damp-off after they get through the soil if they are given proper cultural treatment.

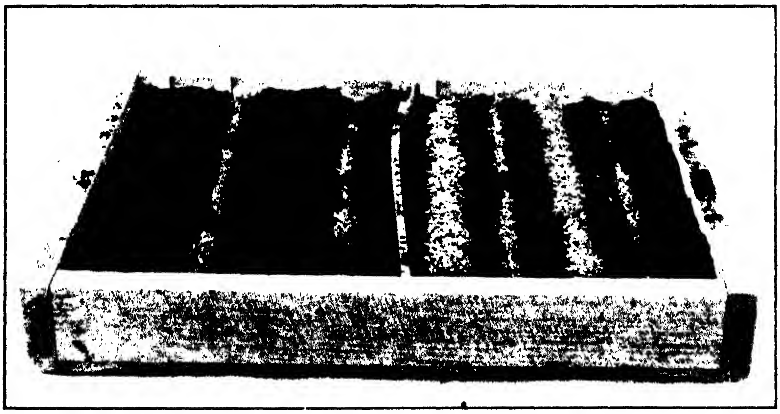


Fig. 2.—Salpiglosis. Soil not treated in left side of flat; right half treated with formaldehyde dust. 1st, 3rd, 5th, and 7th rows—seed not treated. 2nd, 4th, 6th, and 8th rows—seed dusted with Semesan. Note stunting effect of Semesan.

The formaldehyde gas escapes from the dust when it is mixed with soil and permeates the soil completely. It either sterilizes the soil or exerts such an inhibitory action on the damping-off pathogens that they do not attack the young seedlings. All the gas has

been liberated and is gone before germination has progressed enough for the seed to be injured. It has been noted that seed planted in formaldehyde dust treated soil emerges 24 to 48 hours later than when planted in untreated soil. They soon catch up, however, and in a few days, usually are larger and better plants than those in untreated soil.

The formaldehyde treatment has certain advantages over steam sterilization of the soil for seed beds or seedling flats. It is less time consuming, more convenient, and requires no special equipment. There is no need of treating the seed for any surface-borne seed diseases, since the outside of the seed is soon sterilized, after it is planted, by the formaldehyde gas in the soil. The soluble salt content of certain soils sometimes is increased by steam sterilization to the point where germinating seed is injured. Using the formaldehyde dust treatment eliminates this danger. One disadvantage of the treatment over steaming is that weed seeds are not killed.

Method of using formaldehyde dust.—The dust is mixed with the soil or propagating medium which is to be used in flats or in a bench for starting seedlings, at the rate of 1½ ounces of a 6 per cent dust per square foot of area when the soil is between 2 and 3 inches deep. The average greenhouse flat is between 2 and 3 inches deep and approximately 2 square feet in area. When used in flats or benches where the soil is deeper than this, a proportionately larger amount of dust must be used. Enough soil should be measured out on a bench, table, or cement floor to fill the flats that are to be planted. If the flats are the size mentioned above, it will take 3 ounces of dust per flat, and the right amount of dust for all the flats should be weighed out and thoroughly mixed with the soil by shoveling it over several times. The flats are then filled, the seed planted, and the flats watered immediately. It is essential that water be applied heavily enough to soak the soil through as soon as the seed is planted. This eliminates all danger of injury. It has been found that if the flats are left dry after planting, injury may occur.

CONCLUSIONS

1. Semesan used as a seed treatment for flower seeds is not a satisfactory control for damping-off. It is not beneficial after the young seedling is through the soil. Some seedlings are stunted by Semesan seed treatment.

2. Mixing a formaldehyde dust in the soil used in flats or seed beds to start flower seedlings is an effective and simple control for damping-off. It is non-injurious to the seed and protects the young seedling both before and after emergence.

COCOANUT MEAL IN THE DAIRY RATION

A. E. PERKINS[1]

Cocoanut oil meal, Copra meal, or ground cocoanut press cake has long been recognized as a suitable feed for dairy cows.

Until quite recently, it has never been used to any great extent in Ohio. However, it is now being produced by at least two large Ohio manufacturers and is being offered to dairymen as a high-protein feed. Because it was a relatively unfamiliar product and was being offered at a price which seemed lower than that of the usual high-protein feeds, there has been considerable demand for information regarding its value and use. While all investigators seem agreed that cocoanut meal is a desirable feed for dairy cows, there is disagreement regarding its exact value as compared with other feeds and regarding the property it is said to possess of causing the secretion of milk of higher fat content than is produced by other feeds.

To obtain additional data regarding these points under Ohio conditions the Jersey herd at the Hamilton County Experiment Farm was divided into two groups as nearly balanced as possible in all respects. These groups were alternated by calendar months in reverse order on the two grain rations being compared, from November, 1930, until March, 1931, inclusive.

Roughages, consisting of mixed hay (timothy and alfalfa), corn stover, and corn silage, from the same source of supply were fed to all cows. The amounts of roughage supplied were estimated from occasional weighings. The cows were weighed regularly on two successive days at the beginning of each month. The live-weight fluctuated considerably, but the net gain over a 4-month period was 362 pounds by the group on the check ration and 321 pounds by the group on the cocoanut ration, constituting a normal gain of approximately ½ pound per day in each group.

The weight of milk produced was recorded at each milking and fat tests were conducted by the Babcock method once each month on 1-day, composite samples.

[1]Note: This work was conducted at Hamilton County Experiment Farm, Mount Healthy, Ohio, under the administrative supervision of C. C. Hayden and M. A. Bachtell. W. E. Weaver was in charge of the work at the farm.

The two grain rations compared were made up as shown in Table 1.

TABLE 1.—Ingredients of the Grain Rations Compared

	Basal or check ration	Cocoanut meal ration
	Lb.	*Lb.*
Corn-and-cob meal	250	200
Ground oats	250	200
Ground wheat	250	200
Cottonseed meal	125	50
Linseed oilmeal	125	50
Cocoanut meal	none	300
Total	1000	1000
Per cent of digestible crude protein	14.07	13.66
Per cent of total digestible nutrients	76.22	76.94

The above grain mixtures were fed at the rate of approximately 1 pound of grain for each 2½ pounds of milk produced.

Only such feed and production records are included in the summaries as were made by cows apparently in good condition and producing liberal quantities of milk over two full, successive, calendar months. Records for 902 cow days on the cocoanut meal ration and 783 cow days on the check ration were available. The comparisons are made on a 902-day basis by multiplying the values obtained on the check ration by the appropriate factor 1.152.

TABLE 2.—Feed Supplied During the Experiment

	Check ration	Cocoanut meal ration
	Lb. (783 days)	*Lb.* (902 days)
Grain mixture	6,425	8,067
Corn stover	2,690	2,870
Mixed hay	5,980	6,900
Corn silage	24,045	27,685
Total digestible nutrients in above feeds*	13,155.9	15,617.8
Total digestible nutrients on 902-day basis	15,155.6	15,617.8
Excess consumed on cocoanut ration	....	462.2

*Percentages from Henry and Morrison tables used.

It will be seen from Table 2 that a surplus of 462.2 pounds of digestible nutrients was supplied by the cocoanut ration. At the average rate of production maintained in the experiment, 1.698 pounds of 4 per cent milk per pound of digestible nutrient, this will account for 784.8 pounds of the surplus milk produced on this

ration, leaving a balance of 807.2 pounds apparently due to the superiority of the cocoanut meal ration, which is 3.19 per cent of the amount of milk produced on the check ration.

TABLE 3.—The Essential Data Regarding Production

	Check ration, 783 cow days	Cocoanut meal ration, 902 cow days
Pounds milk produced	17,489.9	21,456.0
Pounds butterfat produced	999.7	1,222.9
Average per cent fat in milk	5.71	5.70
*Pounds of milk of 4 per cent content equivalent to observed production	21,991.2	26,925.9
Pounds 4 per cent milk for 902-day period	25,333.9	26,925.9
Excess on cocoanut meal ration	....	1,592.0
Milk per pound of digestible nutrients supplied, pounds	1.671	1,724.0
Average, pounds	1.698	....
Milk equivalent of 462.2 pounds extra digestible nutrients supplied on cocoanut ration, pounds	784.8	....
Remaining surplus milk favoring cocoanut ration, pounds	807.2	....
Surplus as per cent of the production on check ration	3.19	....

*By Gaines' Formula, weight 4 per cent milk = .4 × weight of milk plus 15 × weight of fat.

TABLE 4.—Prices and Average Analysis* of Feeds Used in Cocoanut Meal Experiment

Feed	Price, 100 pounds	Digestible crude protein	Total digestible nutrients
Ear corn	$1.02	6.1	781
Oats	1.28	9.7	70.4
Wheat	1.24	8.7	79.7
Above farm grains, equal-part mixture	1.18	8.2	76.1
Cocoanut meal	1.58	18.6	78.8
Cottonseed meal	1.88	33.4	75.5
Linseed oilmeal	2.40	30.2	77.9
Equal-part mixture cottonseed and linseed oilmeals	2.14	31.8	76.7
Grinding and mixing	0.15	....	....

*The prices are those prevailing at the time and place of the experiment. The average analyses are based on the tables of Henry and Morrison.

Since the production on the cocoanut meal ration was about 3 per cent greater and the cost of the ration slightly less (as shown in Table 4), it follows that the substitution of cocoanut meal for part of the cottonseed and linseed oilmeals of the dairy ration was desirable under the price conditions which prevailed at the time and place of this experiment. Because it is much lower in protein content than the cottonseed and linseed oilmeals, however, the substitution can not be made directly pound for pound without lowering to a marked degree the protein content of the resulting mixture. More of the cocoanut meal must be used, replacing part of the home-grown grains, as well as the high-protein concentrates. This feature is undesirable when home-grown grains are available but makes no difference under conditions where the entire grain mixture must be bought.

In this experiment 300 pounds of cocoanut meal replaced 75 pounds each of cottonseed meal and linseed oilmeal and 50 pounds each of corn, oats, and wheat. The resulting mixture was slightly lower in digestible crude protein and slightly higher in total digestible nutrients than was the check ration, as shown in Table 1.

Since the mixture containing the cocoanut meal was at least as valuable as the check ration in point of production, it follows that the cocoanut meal must have been fully as valuable as the material it replaced and since it was already ground the value assigned to the farm grains in this comparison should include a grinding charge. Assuming that 10 cents per 100 pounds is the part of the grinding and mixing charge due to grinding, 300 pounds of cocoanut meal become equal in value to 150 pounds of cottonseed-linseed mixture, and 150 pounds of the equal-part mixture of farm grains, in addition to a 15-cent allowance for grinding. This amounts, at the prices shown in Table 4, to $5.13 for the 300 pounds of cocoanut meal, or $1.71 per hundred weight. The dairyman should be safe in paying for the cocoanut meal a price derived in this manner, which is roughly obtained by striking an average between the price of the ground farm grains and the average price of prime cottonseed meal and linseed oilmeal.

As shown in Table 3, the experiment fails to confirm the view, suggested by some experimental evidence and given much publicity, that the use of cocoanut meal tends to increase the percentage of fat in the milk produced. On the contrary, it tends to support the more generally accepted idea that little can be done to modify the fat content of milk by the use of specific feeds.

The results have also been studied by eliminating the records of two cows fed the cocoanut meal ration during the months of February and March, which reduces the number of cow-days on the cocoanut meal ration to 784 for comparison with the 783-day period on the check ration. Although, of course, the figures were changed, the general significance of the results was not greatly different.

CONCLUSIONS

The conclusions seem justified that, under price conditions comparable with those applying to this experiment (which are shown in Table 4), cocoanut meal is a desirable substitute for the more familiar high-protein materials. It may probably be used to advantage when its price is below that of a mixture consisting of 50

per cent ground corn or oats or wheat alone or in mixture, and 25 per cent each of prime cottonseed meal and old-process linseed oil-meal.

On the basis of a single experiment conducted under conditions which were far from ideal from an experimental standpoint, however, the writer does not feel justified in committing himself to a more definite statement of their relative values.

The fat test of the milk produced was not increased by the use of the cocoanut meal.

RELATIVE EFFICIENCY AND PROFITABLENESS OF THREE GRADES OF FEEDER STEERS

PAUL GERLAUGH AND C. W. GAY

There are many different classes and grades of feeder cattle available for purchase at the terminal livestock markets. The major portion of these feeder cattle move to the markets during the late summer and fall months.

Many Ohio cattle feeders desire to purchase feeder cattle during October and November, feed them during the winter months, and market these cattle before the work involved in preparation for another year's crops demands full time.

It is shown in Ohio Extension Service Bulletin, Vol. XXI, No. 3, that a seasonal variation exists in the relative prices of various grades of fat cattle. March, April, and May invariably see the plainer grades of fat cattle sell very close to choice, fat cattle.

Many of our beef cattle feeding experiments have sought to find preferable rations and have fed different rations to groups of cattle belonging to the same grade.

The test reported here used the same ration for three different grades of yearling feeder steers.

The Ohio State University cooperated with the Experiment Station in conducting the test. The cattle were purchased by the University and fed on their premises. Dr. C. W. Gay, chairman of the Animal Husbandry Department of the University, had direct charge of the work.

On November 12, the three lots of steers were purchased on the Chicago market. The choice lot of steers cost $9.00 per cwt. They were Herefords in good feeder flesh and showed uniformity typical of this grade of cattle. The medium lot of steers cost $7.00 per cwt. Most of this lot of cattle were red in color and showed

nearly as good body conformation as the choice lot. However, many of this group had horns, and some of the steers were "staggy" in the head, horn, and neck. The common lot of steers cost $5.00 per cwt. and were, for the most part, steers of the dairy breeds. Six of these steers were clearly of Holstein breeding; two had the color and body characteristics of the Guernsey. Two of the steers had the markings of the Herefords, though not the body conformation usually associated with the breed. One steer was white and another the typical brindle familiar to most cattlemen.

The November 12th issue of the Chicago Daily Drovers' Journal quoted stocker and feeder cattle as follows:

Inferior stockers	$4.50 — $5.25
Stockers, common to fair	5.25 — 5.75
Stockers, fair to good	5.75 — 6.50
Stockers, good to choice	6.50 — 7.50
Fancy yearling stockers	7.50 — 8.75
Feeders, common to fair	5.50 — 6.25
Feeders, fair to good	6.25 — 7.00
Feeders, good to choice	7.00 — 8.25
Fancy yearling feeders	8.25 — 9.00

The three lots of cattle were started on test December 9, 3-day weights being averaged for their initial, experimental weight. All lots were fed 10 pounds of silage and 1½ pounds of protein supplement per steer per day throughout the test. The protein supplement was one-half linseed meal and one-half cottonseed meal. Soybean hay was fed according to the appetites of the steers. The amount varied from about 4 pounds per steer daily at the start of test to about 2 pounds when the cattle reached a full feed of corn. Corn was full fed as corn-and-cob meal.

Six pigs followed the three lots of steers. It was possible for the pigs to go from one lot to another. The pork credit is prorated according to the amount of corn consumed by each lot of steers. Protein supplement was fed to the pigs and the pork credit adjusted to care for this cost.

Appraisals were placed on the various lots of cattle on April 17 by representatives from the Cleveland, Pittsburgh, and Cincinnati markets, by David Davies, a Columbus packer, and by Walter Asman, a butcher from Marysville, a city of about 3,600 population.

These appraisals are listed and show a decided appreciation of the better quality steers at the terminal markets; whereas the local butchers appraised the lower grades relatively higher than the terminal market salesmen.

The performance of the three lots is shown for the 140-day feeding period, December 9 to April 28. On April 30, Lot 3 was sold to a Columbus packer for $7.10 per cwt., feed-lot weight, with

a 3 per cent shrink. This would be the equivalent of $6.88 per cwt., feed-lot weight. Lot 3 returned 73 cents per bushel for the corn they consumed after paying the prices listed for the other feeds.

Lot 2 would have returned 62 cents per bushel for the corn consumed, if they had been sold at this time for $7.75 per cwt., feed-lot weights. Lot 1 would have returned 36 cents under the same method of calculation.

Lot 2 was fed for an additional 4 weeks. On May 28 they were sold for $7.10 per cwt., feed-lot weight, with a 3 per cent shrink. This was exactly the same figure Lot 3 sold for 4 weeks earlier. The same packer purchased this lot of steers.

Lot 1 was fed for 4 weeks longer than Lot 2 and sold to another Columbus packer for $8.25 per cwt., feed-lot weight, with a 3 per cent shrink.

The Chicago Daily Drovers' Journal gives the following as the average weekly beef cattle prices for the Chicago market:

Week of	700 lb. to 1050 lb.	1000 lb. to 1200 lb.
	Dollars	*Dollars*
April 18, 1931	7.00	7.35
April 25, 1931	7.50	7.75
May 2, 1931	7.50	7.65
May 9, 1931	7.30	7.25
May 16, 1931	7.25	7.25
May 23, 1931	6.65	6.85
May 30, 1931	6.35	6.60
June 6, 1931	7.15	7.25
June 13, 1931	7.65	7.86
June 20, 1931	7.75	7.65
June 27, 1931	7.10	7.10
July 4, 1931	7.20	7.25

The loss per steer and the returns per bushel of corn fed are shown in Table 1 for the three lots when sold and for Lots 1 and 2 at the end of 140 days, when Lot 3 finished its test and was sold.

There was less variation in the average daily gains of the three lots than many might anticipate. Lot 3 had the lightest and the heaviest gaining steers of the three lots for the 140 days. The steers showing characteristics of the dairy breeds made satisfactory gains; whereas the steers with characteristics indicative of poor breeding, regardless of breed, made less satisfactory gains. These more or less nondescripts did not consume as large quantities of feed, judging from their performance and stay at the feed trough.

The trend of the beef cattle market during the period when this test was conducted would not be considered normal. The Chicago Drovers' Journal (May 4, 1931) states that the average

margin between October feeder cattle prices and the following April fat cattle prices for the last 8 years was $3.15. The average price of stocker and feeder steers last October was $7.30; whereas the average price of fat cattle during April was $7.90.

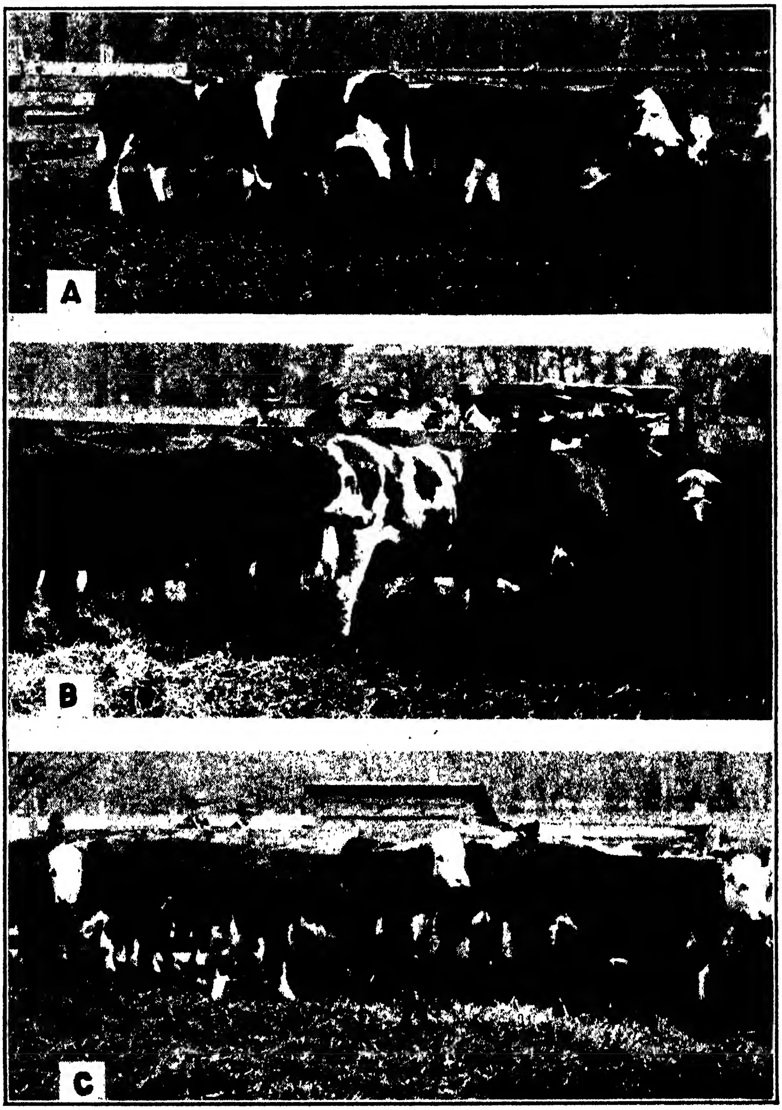


Fig. 1.—University Test. April 17, 1931

a. Common grade steers
b. Medium grade steers
c. Choice grade steers

The lower the level of cattle prices, the greater is the necessary margin for a given return per bushel of corn or per steer; for instance, if we assume that three groups of steers, costing $5.00, $7.00, and $9.00 per cwt., were fed 150 days and gained 2 pounds per day at a cost of $10.00 per cwt. of gain, the $5.00 cattle would require a margin of $1.57 per cwt. to break even; the $7.00 cattle a margin of $.94, and the $9.00 cattle a margin of $.31.

TABLE 1.—Relative Efficiency and Profitableness of Different Grades of Feeder Steers
Experiment 650
Ohio State University—1930-1931

	Lot 1				Lot 3
	Dec. 9 to April 28	Dec. 9 to June 23	Dec. 9 to April 28	Dec. 9 to May 26	Dec. 9 to April 28
Number of steers in lot	12	12	12	12	12*
Number of days in test	140	196	140	168	140
Average weight at start, lb.	658	658	670	670	631
Cost per cwt. at start †	$ 9.50	$ 9.50	$ 7.50	$ 7.50	$ 5.50
Average weight at close, lb.	960	1087	1007	1086	959
Average daily gain, lb.	2.15	2.19	2.40	2.47	2.33
Average daily ration, lb.:					
Corn-and-cob meal	13.6	13.93	14.6	14.9	14 6
Protein supplement	1.5	1.5	1.5	1.5	1.5
Corn silage	9.95	9.96	9.98	9.98	9.99
Soybean hay	2.19	1.99	2.23	2.19	2.25
Feed per 100 lb. gain, lb.:					
Corn-and-cob meal	632.12	637.16	606.7	602.6	627.4
Protein supplement	69.65	68.57	62.34	60.61	64.3
Corn silage	461.85	455.39	414.9	403.5	428.8
Soybean hay	101.6	90.96	92.6	88.47	96.2
Feed cost per cwt. gain	$10.89	$10.80	$10.24	$10.08	$10.59
Market appraisal (April 17):					
Pittsburgh	$ 9.00	....	$ 8.25	....	$ 6.75
Cleveland	9.00	....	8.00	....	6.75
Cincinnati	8.75	....	8.00	....	6.25
Columbus (David Davies)	8.00	....	7.25	....	6.50
Marysville (Walter Asman)	8.00	....	7.25	....	6.75
Actual selling price (3% shrink)	8.55‡	8.25	7.75‡	7.10	7.10
Gain on hogs following cattle, lb.	....	362	....	332	253
Loss per steer (pork included)	$12.07	$20.80	$ 5.37	$15.32	$ 1.95
Returns per bushel of corn	.35	.27	.61	.37	.73

*Steer died Jan. 21—not charged to lo
†50¢ per cwt. added to Chicago cost.
‡Used as appraisal at end of 140 days on feed.
Feed prices: corn-and-cob meal, 80¢ for 70 lb.; protein (equal parts linseed and cottonseed meal), $37.50 a ton; silage, $5.50 ton; soybean hay, $21.00 a ton. Hogs, $6.25 per cwt. net.

CONCLUSIONS

1.—The amount of beef breeding which feeder cattle exhibit is not a yard stick in determining efficiency in turning feed into gains.

2.—Dairy-bred steers make more efficient use of feed than poor individuals of the beef breed.

3.—The cheaper grades of feeder cattle and a short feeding period have an advantage in times of a declining market.

4.—Feeder steers of the dairy breeds are doubtless produced with more satisfactory returns to the breeder than the scrubs of the beef breeds.

5.—Market prices doubtless play a more important part in determining profitableness of cattle feeding than any other factor.

6.—The lower grades of fat cattle sell relatively higher than the better grades during the spring season.

7.—Sometimes the local butchers or small packers offer a better price than terminal markets for plain grades of fat cattle.

THE CAUSES OF SOFT PORK

W. L. ROBISON

The soft pork problem was long regarded as chiefly a southern one. Corn-fed hogs were sufficiently firm to be satisfactory, and a large share of the commercial pork of the country was produced in the corn belt area. Corn and hog production are still closely associated, but within recent years the problem of soft pork in the corn belt has become one of real concern to the packers who are in a position to observe any marked change in the number of soft hogs being marketed.

OBJECTIONS TO SOFT PORK

A soft or oily condition of pork products makes them more difficult to sell. Lard from soft hogs is a sloppy semi-liquid mass which does not properly harden at ordinary temperatures. The sausage will not hold its shape. Because of the softness of the fat contained, loins from soft hogs become smeary and unattractive in appearance when placed on the counter or in the show case. The bacon is soft and flabby, presents a displeasing appearance, and is difficult to slice, even with a machine. Since they carry less fat, the hams are affected to a less extent than some of the other cuts, but even these are not as attractive as those from firm hogs. Such characteristics cause soft pork products to be strongly discriminated against.

Whether hogs will kill out soft cannot be determined by observation or by handling them before they are slaughtered. In sections where soft hogs are more or less common, the inability to detect them while they are alive often works a hardship on the producer of firm hogs, for the packer usually protects himself by buying all hogs at a discount in price which will compensate for the lower value of the average number of soft hogs received.

The information concerning soft pork summarized in the following discussion was obtained largely from the published reports of the cooperative soft pork investigations carried on by the United States Department of Agriculture and a number of state experiment stations, including the Ohio Station, from 1925 to 1929. The data are presented in greater detail in United States Department of Agriculture Bulletins 1407 and 1492, and in the literature cited in these. Other recent publications discussing soft pork are Bulletin 340, of the Indiana, and Bulletin 366 of the Illinois Experiment Station.

HIGH OIL FEEDS CHIEF CAUSE OF SOFTNESS

The firmness of pork depends almost entirely on the firmness of the fat it contains. The degree of firmness of a fat under a given set of conditions depends on its composition. Since the fat of an animal is derived from the feed it receives, feed is the outstanding factor in determining the character of the animal fat produced.

The fat or ether extract in most of the feeds commonly fed to hogs is soft and, in many instances, is an oil or liquid at ordinary temperatures. Pigs have been found to take the fats of feeds as they are and store them in their bodies without changing them materially.

While they are young, pigs ordinarily lay on or store relatively small amounts of fat. During this stage of development, when the growth impulse is strong, a ration that is not high in fat may, nevertheless, contain a sufficient amount to furnish all that is needed by the animal for forming what fat is then being stored. As pigs become heavier and approach market maturity they lay on fat much more rapidly. At this later stage, unless the ration is high in fat, it will no longer furnish enough to meet the requirements for that being laid on or stored by the animal. Hence, the animal must then synthesize or build up the remainder needed from some other material in the ration; consequently, it draws upon the carbohydrates in the feed for fat production, as well as for the production of heat or body warmth and energy. The animal is also capable of using proteins if necessary for the production of body fat. The animal fat produced from carbohydrates and proteins is hard or firm. As a result of this, if the ration is reasonably low in fat, as a hog improves in condition and the amount of fat being deposited increases, its fat ordinarily gradually becomes firmer. The explanation is that an increasingly larger percentage of the fat is being produced from the carbohydrates of the feed.

Investigations have shown that medium-type pigs, fed rations reasonably low in fat, kill out soft until they reach a weight of 175 pounds or so. If pigs on such rations are not slaughtered until they have reached this, or a heavier, weight, their carcasses are usually firm.

Wheat and rye average approximately 2 and 1.8 per cent of fat, respectively. Barley, on a hull-free basis, analyzes about 2.5 per cent of fat. Polished rice and brewers' rice contain around 0.4, and potato flour around 0.8 per cent of fat. These all classify as low-oil feeds. Corn contains an average of about 4.8 per cent of fat and is only relatively low in oil. Oat kernels, or the portion of oats which pigs are capable of utilizing, contain from 6.5 to 8 per cent of fat. Hominy feed usually ranges from 6 to 9 per cent of fat.

SOYBEANS PRODUCE SOFT PORK

Soybeans and peanuts are high in oil. Although soybeans vary considerably in both their protein and fat content, they average approximately 36.5 per cent of protein and 17.5 per cent of fat. Pigs, not on forage, carried from weaning time to 200 pounds in weight, would require an average of about one pound of soybeans to 4.5 pounds of corn to balance the ration. This mixture would contain approximately 7 per cent of fat. Since a higher percentage of their fat is formed from the softening fats in the feed and a lower percentage from the carbohydrates, pigs fed corn and soybeans kill out softer at the same weight and condition than do similar pigs fed corn and tankage or other rations that are lower in fat. Investigations have shown many carcasses from hogs fed soybeans to be objectionable because of their softness.

In Ohio tests, cooking soybeans greatly improved their worth for swine feeding but did not overcome the danger of their causing soft pork. Soybean oilmeal, or soybeans from which a large share of the oil has been removed, was found to produce pork of a satisfactory degree of firmness. As may be observed from the figures given above, the average oil content of hominy feed corresponds closely to that of a mixture of corn 4.5, soybeans 1. In Bulletin 340 of the Indiana Experiment Station, Scott reports that four litters fed hominy feed showed a high proportion of soft carcasses.

RATE OF FAT STORAGE OR OF GAIN AFFECTS FIRMNESS

Although the nature of the ration fed is the chief factor in determining the firmness of the pork, under certain conditions, the rate at which the animal deposits or lays on fat may become the controlling factor in producing soft or firm pork. Rations that are not extremely high in fat and that would produce firm pork under favorable conditions, and yet are sufficiently high in fat to produce soft carcasses under unfavorable conditions, might be designated "border-line" rations. Because of the interrelation of the various factors involved, among which might be mentioned the relative amounts of hardening and softening fats in the feed, different "border-line" rations need not necessarily contain approximately the same percentage of fat. With corn and soybeans for medium-type hogs, however, those containing one pound of soybeans, analyzing 17.5 per cent fat, for every 9 to 12 pounds of corn, or from 5.75 to 6 per cent of total fat, would probably fall within this class.

As previously mentioned, the faster the rate of fat deposition or rapidity of gains, the greater is the utilization of the carbohydrates for the formation of animal or body fat. It was also mentioned that the fat formed from carbohydrates is firm whereas that formed from the fat of the feed is usually soft in character. Hence, in a group of pigs that have received a "border-line" ration, those that have made rapid gains or stored their fat at a rapid rate may kill out firm; whereas those that have gained more slowly, or laid on their fat less rapidly, and consequently synthesized a smaller percentage of it from the carbohydrates of the feed, may kill out soft.

TYPE OF HOG INFLUENCES HARDNESS OF FAT

Type is another factor which exerts an influence, under certain conditions, on the firmness of the pork. Rangy pigs may gain as fast or faster than pigs of a more compact type, but for a longer period of time they tend to grow rather than fatten. Since the growth impulse in chuffy-type pigs is not so strong, they tend to lay on fat at a lighter weight than do those of a more rangy type. Thus, a rangy pig is not as fat at a weight of 200 or 225 pounds as is a more compact one. Because of the difference in condition, a rangy animal will kill out softer, at a given weight, than will a more compact one that has received the same ration.

In a test at the Ohio Station, when both were slaughtered at a weight of 200 pounds, Duroc Jersey, or lard-type pigs, killed out

firmer than did more stretchy Yorkshire, or bacon-type, pigs of the same weight, which had been similarly fed. The average thickness of the back fat on the lard-type hogs was 1.59 inches; whereas that on the bacon hogs was 1.45 inches.

In order for rangy hogs to be as fat as shorter or more compact ones it would be necessary for them to carry a thicker covering of fat, as measured by actual depth. Stated differently, for the fat covering to be as thick proportionally, rangy hogs would need to carry a greater depth of fat in actual inches than would more compact ones. Consequently, intermediate or chuffy-type hogs would be expected to be firmer than rangy hogs having the same thickness of fat covering.

RATIONS LOW IN FAT PRODUCE FIRM PORK

Since a large share of their fat has been produced from carbohydrates, pigs, which have received feeds like brewers' rice, potatoes, rye, wheat, or barley, kill out firm, even when slaughtered at relatively light weights or while carrying a comparatively thin covering of fat. Navy beans produce soft pork and apparently differ in some respect from the other low oil feeds. In the cooperative soft pork investigations, pigs fed brewers' rice from shortly after weaning time and slaughtered at a weight of 200 pounds had an exceptionally firm fat. If allowed to reach normal marketing weights, even rangy type pigs given barley or other low-oil feeds will produce firm carcasses. On the other hand, if corn makes up the bulk of the ration, some of the extremely rangy pigs will not carry sufficient fat to kill out firm, when they are slaughtered at weights of 225 pounds or less. To produce hogs of equal finish at a given weight, a somewhat stretchier type is required for self than for hand feeding. Pigs given a fibrous or bulky ration are not as fat at a given weight as are those of similar type on a more concentrated ration. Rations low in protein and minerals retard muscular and skeletal growth and cause the animals to be fatter at a given weight than similar ones on a fully adequate ration.

FIRMNESS OF CORN-FED HOGS INFLUENCED BY FINISH

In the hog belt of the United States, where corn usually makes up a large share of the ration, the demand for a lean or meat type hog carrying a small percentage of fat and yet killing out firm is a difficult one to fill. On a corn ration a thin covering of fat and a firm fat are more or less incompatible. Perhaps the nearest

feasible solution to the problem at present is for producers to avoid both extremes in type, the chuffy hog, because it is excessively fat at usual market weights, and the extremely rangy hog, because it is not sufficiently finished to kill out firm, unless it is carried to a heavy weight, and then to market the vast majority of hogs at weights ranging from 200 to 225 pounds. A consistently higher price for hogs of the proper weight and degree of finish would probably do more than any other one thing to encourage the marketing of hogs at the most desirable weight and condition, so far as the demands of the consumer are concerned.

RECEIPTS OF PRODUCE ON THE COLUMBUS WHOLESALE MARKET, 1930

CHAS. W. HAUCK

For the third successive year, the Department of Rural Economics of the Ohio Agricultural Experiment Station has analyzed the receipts of farm produce in trucks on the Producers' Wholesale Curb Market in Columbus. These receipts are reported daily by the Division of Markets of the Ohio Department of Agriculture. The arrivals in the last 6 months of 1928 and in the year 1929 are recorded in Mimeograph Bulletins Nos. 16 and 25 of the Department of Rural Economics, and the receipts in 1930 are set forth in Bulletin No. 40 of that series.

The volume of fresh fruits and vegetables arriving in Columbus in motor trucks has grown steadily since the inauguration of this reporting service on July 2, 1928. The gradual development of high-speed trucks and the expansion of hard-surfaced highways are exerting a marked influence on methods of marketing and transportation and, in the particular market under consideration, have resulted both in an increase in the arrivals by truck and in an extension of the area from which supplies are drawn.

This expansion doubtless may also be traceable to the long-continued drouth affecting nearby sources of supply in 1930. The reduction of local supplies, due to unfavorable growing conditions, apparently encouraged shipments from greater distances and from sources seldom drawn upon. Several Ohio counties that usually

are important sources of supply for Columbus furnished only small quantities in 1930. Uncertain marketing conditions may also have been responsible for some producers driving unusual distances in the hope of finding a favorable selling situation.

During 1930, 58 Ohio counties and seven states outside Ohio furnished supplies in motor trucks on this market. Trucks from Michigan were reported regularly during the height of the season, bringing mainly small fruits and celery. Two truckloads of green beans arrived from North Carolina and one truckload of pecans was received from Mississippi.

Refrigeration may, in the near future, expand even further the territory furnishing supplies in trucks in so-called "local" markets, such as Columbus. In 1930 at least one truckload of produce arrived from northern Ohio in a truck with refrigerated body. Thus far in this territory the refrigerated truck seems to have been looked upon as being only in the experimental stage, and yet, if this means of transportation of perishables proves effective and economical, it may very easily have far-reaching influences on the marketing of these commodities.

Receipts are recorded in original units, such as bushels, bunches, dozens, crates, etc., but in this analysis were converted into pounds for purposes of comparison; likewise, carlot unloads were converted into pounds in order to express all arrivals in comparable terms. A comparison of the receipts in Columbus during the last 3 years is given in the following table:

Comparison of Receipts in Trucks—1928, 1929, and 1930

	1928*	1929	1930
Total number of truckloads	7,025	12,069	11,320
Truckloads from other states	29	19	273
Truckloads from Franklin County	4,062	8,013	7,687
Number of Ohio counties represented	44	38	58
Number of other states represented	3	4	7
Total weight of products received	13,328,465 lb.	18,948,246 lb.	20,248,388 lb.
Average net weight per truck	1,897 lb.	1,570 lb.	1,788 lb.
Average one-way haul per truck	30.3 mi.	18.9 mi.	27.0 mi.
Total round-trip distance traveled	425,570 mi.	456,432 mi.	612,110 mi.
Heaviest monthly receipts	August	August	September
Heaviest monthly receipts	2,227 trucks	2,809 trucks	2,450 trucks
Heaviest monthly receipts	4,165,252 lb.	5,094,266 lb.	5,229,960 lb.
Heaviest weekly receipts	547 trucks	656 trucks	589 trucks
Heaviest weekly receipts	1,034,554 lb.	1,270,789 lb.	1,356,082 lb.
Heaviest daily receipts	140 trucks	159 trucks	175 trucks
Heaviest daily receipts	269,787 lb.	336,728 lb.	389,400 lb.
Estimated value of receipts	....	$740,301.25	$744,141.53
Per cent of supplies arriving in trucks	11.7	8.4	10.3
Number of commodities offered	43	78	79

*Last 6 months only.

Franklin County, in which Columbus is located, furnished 67.9 per cent of the truckloads and 42 per cent of the produce recorded in this market in 1930. Pickaway County ranked second with 11.3

per cent of the truckloads and 13.8 per cent of the produce. The State of Michigan ranked third with 1.9 per cent of the truckloads and 9.6 per cent of the produce. Here is evidence that many trucks from nearby sources are of small capacity or are not fully loaded, while practically all of those from distant points are of large capacity and are heavily loaded.

Two hundred and seventy-three trucks carrying more than two million pounds of produce arrived from states other than Ohio. This represents 2.4 per cent of the truckloads and 10.6 per cent of the produce, a much larger volume than in either of the years previously recorded.

In quantity and in value, tomatoes led the list of truck arrivals in 1930, with just short of three million pounds selling for more than $137,000. Green corn ranked second with arrivals of about two and one-third million pounds selling for about $57,000. Tomatoes, corn, potatoes, apples, cantaloupes, and cabbage accounted for 53 per cent of the volume received in trucks in this market in 1930 and for 47 per cent of the value.

Saturday's receipts exceeded those of any other day. As a rule, approximately one-fourth of the produce received in trucks during the week arrived on that day. Daily arrivals ranked in the following order: Saturday, Tuesday, Thursday, Wednesday, Friday, and Monday. The largest, single day's receipts were recorded on Saturday, August 30, with 175 truckloads aggregating 389,400 pounds.

September receipts in the growers' market exceeded those of every other month, with arrivals of 2450 trucks containing 5,229,960 pounds of produce. In 1928 and 1929, August was the month of heaviest receipts in trucks. More than one-fourth of all the truck receipts recorded during the year 1930 arrived in September, giving evidence of a local harvest season somewhat later than usual. The months of July, August, September, and October furnished 80 per cent of the total for the year.

THE CHATTEL MORTGAGE SITUATION IN UNION COUNTY, OHIO

V. R. WERTZ

In 1930 there were 2,324 mortgages recorded in Union County, securing $957,474. In 1910 there were 349 chattel mortgages recorded in the county, and the amount loaned on these mortgages was $105,747. In 1920 the number of chattel mortgages registered in the county during the year had increased to 550, and the amount secured by these mortgages had increased to $304,700. In 1929 the number of mortgages recorded had reached 2,659 and the amount borrowed had increased to $1,130,075, an increase of 662 per cent in the number of chattel mortgages recorded since 1910 and an increase of 969 per cent in the amount borrowed on these mortgages. By 1930 the number and amount of recorded chattel mortgages had decreased slightly from the high mark of 1929.

TABLE 1.—Number and Amount of Chattel Mortgage Loans Recorded in Union County in 1930

	Number of chattel mortgages recorded	Average amount per chattel mortgage (Dollars)	Total amount of money borrowed on chattel mortgages (Dollars)
All residents in Union County	2,324	412	957,474
Rural residents	1,521	352	536,035
City and village residents	803	525	421,439

The number and amount of chattel mortgage loans recorded in Union County since 1910 can not be taken as the actual trend in the chattel loan business in the county, for, in all probability, a larger percentage of the loans made in recent years have been secured by chattel mortgages than in former years. In recent years, especially since the development of chattel mortgage loan companies, there has been a tendency for those making loans to take a mortgage on more than one chattel; for example, if a farmer wishes to borrow a small amount of money he may have to list the major portion of his chattels as security. This means, of course, that the dealer who sells this farmer a binder, for example, must now take a mortgage on the binder in order to protect himself; otherwise, a loan company making the farmer a loan may list the binder as security for this loan and thus have a prior lien on the binder. This has forced many dealers who formerly took promissory notes to take chattel mortgages instead.

One cause for the relatively large size of city and village loans is that several of these loans in cities and villages were made to dealers for the purpose of financing their purchases from wholesalers until their goods had been resold at retail. Several of these dealers' loans amounted to $4,000 each.

Slightly more than one-third of the funds loaned to farmers on chattel mortgages in Union County in 1930 came from banks, 15 per cent came from finance companies, 13 per cent from motor sales companies, 10 per cent from implement dealers, ½ per cent from insurance companies, and 25 per cent from miscellaneous sources, such as hardware stores, feed stores, furniture stores, etc.

TABLE 2.—Source of Chattel Loans to Farmers in Union County in 1930

	Banks	Finance companies	Motor sales companies	Implement dealers	Insurance companies	Miscellaneous (individuals and companies)*	Total
Dollars	191,257	82,389	71,454	55,104	2,466	133,365	536,035
Per cent	35.7	15.4	13.3	10.3	.5	24.8	100

*Including music stores, hardware stores, furniture stores, gas and electric companies, typewriter, adding machine, and cash register companies, etc.

TABLE 3.—Source of Chattel Loans to City and Village Residents in Union County in 1930

	Banks	Motor sales companies	Finance companies	Miscellaneous (individuals and companies)*	Total
Dollars	208,679	53,732	37,991	80,095	421,439
Per cent	54.8	14.1	10.0	21.1	100

*Including music stores, hardware stores, furniture stores, gas and electric companies, typewriter, adding machine, and cash register companies, etc.

Banks furnished over half of the chattel loan funds to city and village residents in the county. A large percentage of these loans from banks were to retailers for the purpose of financing their purchases from wholesalers. Motor sales companies furnished 14 per cent of the funds to city and village residents, finance companies 10 per cent, and the amount coming from all other sources—wholesale and retail dealers and individuals—amounted to 21 per cent.

LIFE OF FARM MACHINERY

F. L. MORISON

Some data on the probable life of the more common kinds of farm machinery are shown in the accompanying table. The data were obtained from about 40 farms in Medina and Greene Counties on which cost accounts were started in 1920. At that time complete inventories of equipment were taken, the original date of purchase of each piece being noted. Contact with the equipment inventories of these farms has been maintained. The farms have an average area of 150 acres.

In the first column of figures is given the average age of machinery discarded since 1920; i. e., junked or traded in on new machinery. In the latter case, the discarded equipment may have been either almost worn out or merely obsolete, but as far as these farmers were concerned it had passed its period of economical service. The replacement of obsolete equipment is a never-ending process. Horse-drawn machines, though not yet worn out, are replaced by machines to be drawn by a larger team or a tractor; some of these in turn are later discarded because they are not adapted to the new general-purpose tractor.

The second column indicates that much of the operating equipment in use on these farms is approaching the average age at which it has been discarded in the past 11 years. This is the result of the unfavorable relationship between prices of farm products and the cost of things farmers buy. These farmers purchased more than twice as many pieces of farm machinery in the 5 years 1916-1920 as were bought during 1926-1930, even though there was little replacement of horse-drawn equipment by the tractor in the earlier period.

The estimated total life of the machinery was secured by adding the present age of the machine and the owner's estimate of its probable future life. The average estimated useful life of all machinery on these farms in 1920 was only 15 years. This difference of 5 years may be attributed principally to the difference in the farmers' optimism and purchasing power in January 1920 and today.

Life of Machinery on Farms in Greene and Medina Counties, Ohio

Equipment	Average age at time of discarding 1920–1930	Equipment in use in 1931	
		Average age	Estimated total life
	Years	*Years*	*Years*
Walking plow	17	16	30
Sulky plow	13	15	21
Tractor plow	8	5	12
Disk harrow	12	13	19
Spike tooth harrow	17	14	22
Spring tooth harrow	16	12	18
Cultipacker	.....	7	17
Roller	24	20	29
Corn planter	13	12	20
Cultivator, 1-row	13	13	19
Cultivator, 2-row	.....	10	16
Rotary hoe	.....	3	.....
Corn binder	13	12	18
Grain drill	14	15	23
Grain binder	17	14	21
Mower	15	15	21
Dump rake	24	16	27
Side delivery rake	17	12	19
Tedder	21	18	25
Hay loader	14	10	19
Manure spreader	10	9	14
Ensilage cutter	11	10	16
Tractor	6	5	9
Average	14	12	20

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

During the first six months of 1931 the prices of Ohio farm products were 26 per cent below those of 1930; while cash income from sales of farm products was 28 per cent less. During the same period, the prices paid for commodities purchased declined 11 per cent. Declining inventory values have also decreased the profits. For the year 1930 a group of Franklin County farmers had average cash receipts of $4,286, cash farm operating expenses of $1,984, and an inventory decrease in livestock and supplies of $842. During the year dairy cattle values declined from $105 to $65 per head on these farms.

Trend of Ohio Prices and Wages, 1910-1914=100

	Wholesale prices all commodities U. S.	Weekly earnings N. Y. State factory workers	Prices paid by farmers for commodities bought U.S.	Farm product prices U.S.	Ohio farm wages	Ohio farm real estate	Ohio farm product prices	Ohio cash income from sales
1913........	102	....	100	100	104	100	105	100
1914........	99	100	101	102	102	102	105	107
1915........	102	101	106	100	103	107	106	110
1916........	125	114	123	117	113	113	121	121
1917........	172	129	150	176	140	119	182	198
1918........	192	160	178	200	175	131	203	243
1919........	202	185	205	209	204	135	218	266
1920........	225	222	206	205	236	159	212	242
1921........	142	203	156	116	164	134	132	136
1922........	141	197	152	125	145	124	127	136
1923........	147	214	153	135	166	122	134	149
1924........	143	218	154	134	165	118	133	150
1925........	151	223	159	146	165	110	159	164
1926........	146	229	156	136	170	105	155	176
1927........	139	231	154	131	173	99	147	163
1928........	143	232	156	139	169	96	154	147
1929........	141	236	155	138	169	94	151	161
1930........	126	226	146	117	154	90	129	128
1930								
January...	136	234	153	134	158	....	141	155
February..	135	231	152	131	....	....	137	124
March.....	133	235	151	126	....	90	132	133
April......	132	231	151	127	158	....	136	140
May.......	130	228	150	124	....	....	132	129
June.......	127	227	149	123	....	....	131	134
July.......	123	224	148	111	155	....	123	114
August....	123	224	147	108	....	....	125	119
September.	123	227	146	111	....	....	129	122
October....	121	220	144	106	147	....	125	130
November.	117	215	142	103	....	....	122	123
December..	114	216	139	97	....	....	112	114
1931								
January...	112	212	138	94	133	....	106	111
February..	110	215	137	90	....	....	98	87
March.....	109	219	136	91	....	82	100	97
April......	107	215	134	91	119	....	103	98
May.......	104	211	131	86	....	....	98	93
June......	....	....	....	....	....	....	93	94

NEW MONOGRAPH BULLETINS NOT PREVIOUSLY ANNOUNCED

No. 471. Lodging in Oats and Wheat, F. A. Welton and V. H. Morris. Factors, other than mechanical impact, causing lodging are studied from a chemical and physiological standpoint.

No. 472. Bloom Period and Yield of Apples, C. W. Ellenwood. Data on date of bloom and yield of 159 varieties of apples are studied in relation to their influence on susceptibility to frost injury and cross pollination.

No. 473. The Sources of American Corn Insects, C. R. Neiswander. An attempt is made to classify the insects attacking corn according to their relationship with the corn plant and to demonstrate the sources, or the food material, from which they came to corn.

No. 474. A Study of Certain Cash Expenditures of Ohio Farm Families, Grace Brinton. The specific expenditures of 70 farm families, which have been classified as "Operating Expense", "Furniture, Furnishing, and Equipment", and "Indications of Comfort", were studied.

No. 475. Manual of Ohio Weeds, H. A. Runnels and J. H. Schaffner. Descriptions of 231 weeds of Ohio are given for purposes of recognition, and practical control measures are suggested for each. Detailed considerations of five of the most troublesome weeds, such as Canada thistle, are included.

No. 476. All-night Light for Layers, D. C. Kennard and V. D. Chamberlin. Experiments with both pullets and hens have been carried, and all-night has made possible the retaining of year-old hens at a profit. Practical suggestions as to feeding and management are also given.

No. 477. Studies on the Nutritive Value of Milk, W. E. Krauss. The deficiencies of an exclusive milk diet and methods of overcoming them are reported in this bulletin.

No. 478. Lumber Production in Ohio, R. R. Paton, with a supplementary section on **Damage to Lumber Caused by Insects,** J. S. Houser. This bulletin presents the forest types of Ohio and discusses the present utilization of them and the advisable future of the industry. The insects attacking lumber are discussed and control measures suggested.

No. 479. Nitrate Fertilization and Keeping Quality of Apple Fruits, J. H. Gourley and E. F. Hopkins. Chemical, physiological, and storage studies of the effects of nitrogen fertilizers on apples are presented.

No. 480. Breeding Experiments with Sheep and Swine, B. L. Warwick. Experiments on "Black" of Shropshire and Merino sheep, "Chalk-face" in Merino sheep, "Entropion or Turned-in Eyelids" in lambs, "Cryptorchids or Ridglings" in sheep, "High-stepping" pigs, "Inheritance of Black" in swine, and "Scrotal Hernia" in swine are reported.

No. 481. Some Factors Causing Variations in Crop Production Costs in Putnam County, John F. Dowler. Data on 23 farms over a period of 3 years reveal wide differences in costs of producing crops due to variations in size of fields, labor costs and accomplishments, use of tractor, yields, optimum time of planting, fertilizers, and methods of doing work.

No. 482. Seasonal Variation in the Rate of Growth of Pre-school Children, Hughina McKay and Mary Ann Brown. The study herein reported revealed that there was little variation from season to season in the foods used by the majority of the children, although there was a definite seasonal variation in growth. The quality of the food in the summer may be more conducive to growth than that of food in winter.

No. 483. Factors Affecting Fruit Setting. I. Stayman Winesap, Freeman S. Howlett. These experiments have shown that fruit setting is largely affected by competition between flowers in the cluster.

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E. A. McCall .... Resident Foreman Southeastern Expt. Farm, Carpenter
Rando C. Beatty .... Resident Foreman Paulding Co. Expt. Farm, Paulding

[1]In cooperation with College of Agriculture, Ohio State University.
[2]In cooperation with the U. S. Department of Agriculture.

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Ohio Agricultural Experiment Station

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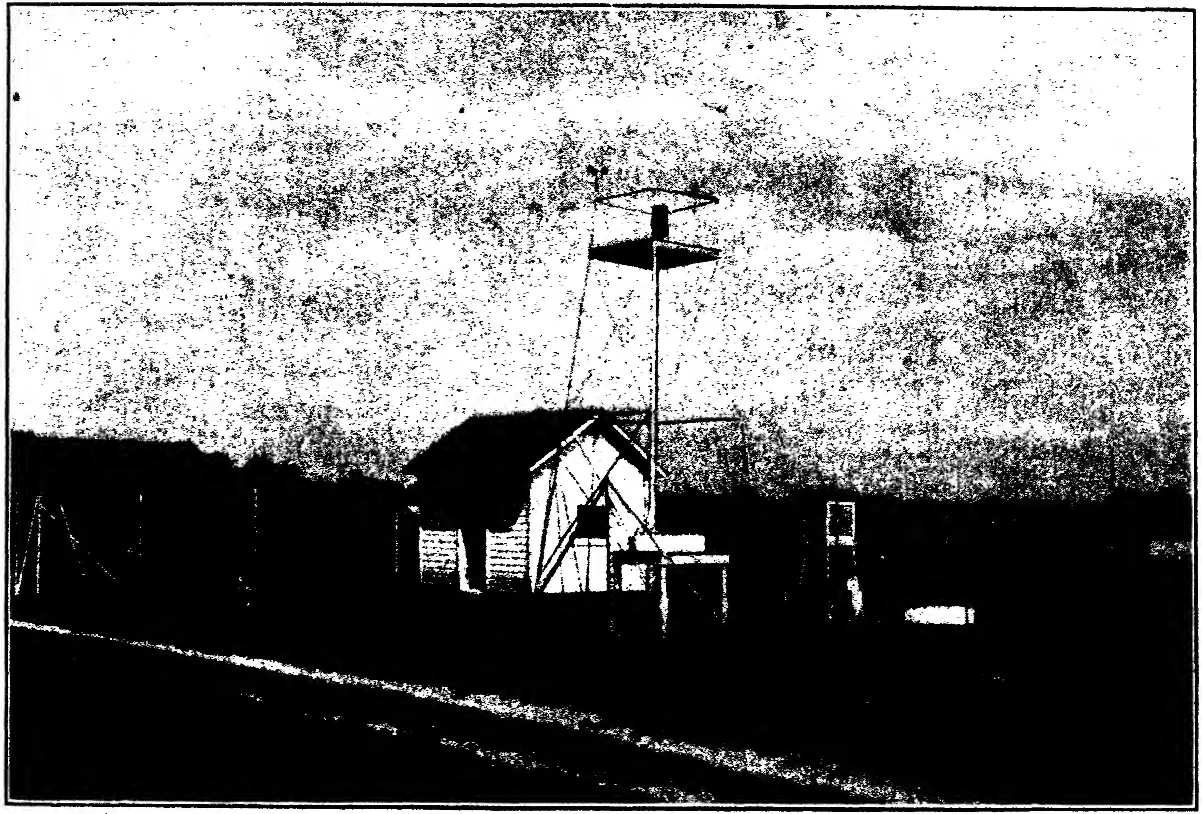
Free Bulletin

C. G. Williams

Director



Weather Bureau

The following are recorded here daily: Temperature, Rainfall, Sunshine duration, Relative humidity, Evaporation, Wind direction and velocity

WHEAT AS A SUBSTITUTE FOR CORN IN THE DAIRY RATION

C. C. HAYDEN AND C. F. MONROE

The recent low price of wheat has led to many inquiries concerning the feeding value of this grain for dairy cows. Although some wheat has occasionally been fed to dairy cows, accounts of actual experimental trials on feeding wheat in comparison to corn are almost entirely lacking in the literature.

A comparison of the chemical analyses of corn and wheat would lead to the conclusion that these two grains would be about equal in feeding value. However, it is only by actually feeding a substance that such factors as palatability, digestibility, and physical effects on the animal can be determined. It is also conceivable that other factors, commonly referred to as "poisonous", may be discovered in a feeding trial. Before this experiment was started, in the fall of 1930, various rumors were heard about wheat feeding; namely, that wheat was not palatable, that it would cause cows to go off feed, and that it would "dry off" cows. It was also claimed that a poisonous substance was present in wheat, which sometimes was conducive to abortions. These rumors may have originated from some early Wisconsin[1] work in which wheat products only were fed. In the fall of 1930, even though wheat was comparatively cheap, many dairymen were hesitant about feeding it because of these reports.

EXPERIMENTAL FEEDING FOR 150 DAYS

The experiment here described was started on October 15, 1930. Eight purebred Jersey and four purebred Holstein cows were divided as evenly as possible into two groups. Both groups were treated alike, with the exception that one received a grain mixture containing corn, while the other received a like mixture, with wheat replacing 75 per cent of the corn. The grain mixtures are tabulated here:

CORN MIXTURE	
Corn	400
Oats	300
Bran	100
Linseed Oilmeal	100

WHEAT MIXTURE	
Wheat	300
Corn	100
Oats	300
Bran	100
Linseed Oilmeal	100

[1] Wis. Agr. Exp. Sta. Res. Bull. 17, 1911.

Alfalfa hay and corn silage were fed to both groups at the rate of 1 and 3 pounds, respectively, for each 100 pounds of liveweight. The average cow, however, when allowed all the hay she will clean up, will eat more than this amount; consequently, emphasis was placed on the grain feeding. Grain was fed according to milk production, at approximately the Savage Feeding Standard.

The two groups were fed in this manner for 75 days. The rations were then reversed, and the feeding was continued for an additional 75 days. The results for these two 75-day periods, or 150 days, are summarized in Table 1.

TABLE 1.—Effect of Wheat and Corn on Milk and Fat Production and Gain in Body Weight, per Cow per Month*

Ration	Milk	Test	Fat	4% milk	4% milk per 100 pounds dry matter	Live-weight gain
	Lb.	*Per cent*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Wheat	801.4	5.10	40.85	933.3	111.6	19.0
Corn	790.9	4.89	38.69	896.8	110.0	33.5
Difference (favors wheat)	10.5	.21	2.16	36.5	1.6	– 14.5

*The results as given in Table 1 are for 11 cows instead of the original 12, because one Holstein cow which showed a tendency to "dry off" prematurely was dropped from the experiment.

To produce 100 pounds of milk the following amounts of feed were required:

On the wheat ration—	Grain, 41	Hay, 34	Silage, 103
On the corn ration—	Grain, 41	Hay, 35	Silage, 105

The averages indicate that for milk production there was little or no difference between the two rations. The differences in milk and butterfat production, as well as in the production of fat-corrected milk (4%), although favoring the wheat ration, fall within the limits of probable error and are not to be interpreted as being significant.

The cows gained 14.5 pounds more in weight per cow per month on the corn ration. This difference is significant from a mathematical point of view and indicates a superiority of the corn ration in this respect. However, it is to be noted that the cows on the wheat ration not only maintained their liveweights but increased 19 pounds per month on the average. Partially compensating for the lower liveweight gains on the wheat ration was the higher butterfat test of the milk produced on this ration, as compared with that produced on the corn ration.

FEED REQUIRED FOR ONE HUNDRED POUNDS OF MILK

The amounts of the various feeds required to produce 100 pounds of 4 per cent milk were practically the same for the two rations. Using present local prices (August 1, 1931), the wheat concentrate mixture would cost $17.36 per ton, and the corn concentrate mixture would cost $20.08[2], the difference between the two mixtures being $2.72. Of course, the alfalfa hay and corn silage cost the same in both rations. The feed cost of 100 pounds of 4 per cent milk was $0.81 on the wheat ration and $0.88 on the corn ration. This cost would vary with variations in the prices of feeds.

EXPERIMENTAL FEEDING CONTINUED TO 225 DAYS

At the end of the 150-day feeding trial just described, eight of the cows were still milking well and were far enough away from their "drying-up" dates to warrant another 75-day feeding period. As these eight cows happened to be equally divided between the two lots, it was only necessary to reverse the rations and continue.

A summary of the results from these eight cows for three 75-day periods is given in Table 2.

TABLE 2.—Effect of Wheat and Corn on Milk and Fat Production and Body Weight Gain, per Cow per Month

Ration	Milk	Test	Fat	4% milk	4% milk per 100 pounds dry matter	Live-weight gain
	Lb.	*Per cent*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
Corn	872.6	4.96	43.29	998.4	122.6	24.6
Wheat	852.9	5.12	43.65	996.0	119.9	11.4
Difference (favors corn)	19.7	.16	.36	2.4	2.7	13.2

These results again indicate that the corn and wheat rations were about equal in value, pound for pound. Similar to the former comparison, these cows gained more in liveweight on the corn ration but gave a slightly lower testing milk than they did on the wheat ration.

HIGH PRODUCTION ON WHEAT RATIONS

Probably one of the best tests of the value of a feed mixture comes when this mixture is fed to high-producing cows, because such cows are handling large amounts of feed and are generally

[2]Prices used: Wheat, 39¢, Oats, 22¢, Shelled corn, 59¢ per bu.; Bran, 95¢, Linseed oil-meal, $1.75 per cwt.; Hay, $15, and Corn silage, $4 per ton.

somewhat more susceptible to digestive upsets. For high production, a feed must be palatable. Four high-producing cows in this experiment averaged, per cow per month, for the 7 months of the experiment, 1049.6 pounds of milk and 48.4 pounds of butterfat on the wheat ration and 1087.5 pounds of milk and 48.9 pounds of butterfat on the corn ration. The average test on the wheat ration was 4.6 per cent and on the corn ration, 4.5 per cent. This group of four cows was composed of the high Holstein and the high Jersey cow in each of the two groups.

The results obtained with these four cows are a very strong indication that the two grain mixtures were practically equivalent. If there were any unfavorable effects from the wheat, they should have shown up with these cows, because they ate liberal quantities of grain.

CONTINUOUS WHEAT FEEDING

Another part of the wheat feeding experiment that may be of practical interest was the continuous feeding (not reversal) of a wheat mixture to a group of 11 cows in various stages of lactation. These cows were fed for 7 months, or from October 15, 1930 to May 15, 1931, on the following grain mixture: 400 pounds wheat, 300 pounds oats, 100 pounds bran, and 200 pounds linseed oilmeal. This concentrate mixture was fed with mixed hay as the only roughage. These cows received no corn silage during the 7 months.

The cows produced normally on this ration and eight of the 11 dropped normal calves. The other three were carrying calves at the end of the experiment. The liveweights of these cows were not quite up to the usual standard of previous lactations. This was especially true of those in heavier production. However, the reduction in flesh was not excessive. The continuous feeding of this grain mixture containing 40 per cent of wheat resulted in no ill effects.

SUMMARY

The results of this experiment, in which corn was replaced by wheat, indicate that the wheat and corn were practically equivalent in feeding value. The wheat grain mixture was fully as palatable as that containing the corn. Liveweight gains were not as high on the wheat ration as on the corn, but this difference was not alarming. The milk produced on the wheat ration was slightly higher in butterfat than that on the corn ration.

A group of cows fed continuously for 7 months on a grain ration containing 40 per cent of wheat showed no ill effects from this feeding. Therefore, we feel that feeding wheat to the extent of one-third of the grain mixture is a safe practice.

Marcella October De Kol 1170340 **Mio Queen 631834**

Mio Queen 631834, highest producing Jersey in experiment. Average monthly production:
On the wheat ration, 1009.8 lb. milk, 50.8 lb. fat, test 5.03%
On the corn ration, 1059.6 lb. milk, 50.9 lb. fat, test 4.80%

Marcella October De Kol 1170340, highest producing Holstein in the experiment. Average monthly production:
On the wheat ration, 1098.9 lb. milk, 50.9 lb. fat, test 4.63%
On the corn ration, 1194.0 lb. milk, 52.6 lb. fat, test 4.40%

PRACTICAL RECOMMENDATIONS

Wheat, like other grains, should be ground for feeding, but, owing to the tendency of wheat to form a pasty, gummy mass in the course of digestion when it is finely ground, we recommend that it be crushed or ground only coarsely for feeding to cows.

The cheapness of wheat may be an incentive to feed it to the exclusion of other grains. Although it is entirely possible to get the proper protein percentage by mixing wheat and a 32 per cent concentrate feed together, it would be better to use some oats and bran also, instead of all wheat. Other feeds may be used also.

Wheat does not fully take the place of bran in the grain mixture, as 100 pounds of wheat contain only 10 pounds of bran. It is recommended that practically as much wheat bran be fed with wheat mixtures as with corn mixtures, especially in low-protein mixes or in those containing small amounts of linseed oilmeal and cottonseed meal. Bran is also valuable for supplying phosphorus.

SUGGESTED GRAIN MIXTURES, (Using Wheat)

To be fed with alfalfa or soybean hay:

Wheat	300 pounds	Wheat	300 pounds
Oats	400 pounds	Oats	400 pounds
Corn	100 pounds	Corn	100 pounds
32% Mix	100 pounds	Bran	100 pounds
		Cottonseed Meal	100 pounds
Salt	8 pounds	Salt	10 pounds
	908		1010

To be fed with clover hay:

Wheat	300 pounds	Wheat	325 pounds
Oats	400 pounds	Oats	300 pounds
32% Mix	200 pounds	Corn	75 pounds
		Bran	100 pounds
		Cottonseed Meal	200 pounds
Salt	7 pounds	Salt	10 pounds
	907		1010

To be fed with mixed hay:

Wheat	200 pounds	Wheat	300 pounds
Oats	200 pounds	Oats	300 pounds
32% Mix	200 pounds	Bran	100 pounds
		Cottonseed Meal	200 pounds
		Linseed Oilmeal	100 pounds
Salt	4 pounds	Salt	10 pounds
	604		1010

To be fed with timothy hay:

Wheat	250 pounds	Wheat	300 pounds
Oats	250 pounds	Oats	300 pounds
32% Mix	400 pounds	Cottonseed Meal	200 pounds
		Linseed Oilmeal	200 ponnds
Salt	5 pounds	Salt	10 pounds
	905		1010

NOTE: If corn is available, it may be substituted for some of the wheat or oats, or both. It would be desirable to feed these three grains together. Cottonseed oilmeal in the above rations mav be entirely or partially replaced by other high-protein feeds, such as linseed oilmeal, soybean oilmeal, ground soybeans, or corn gluten meal. Not more than 3 pounds of ground soybeans should be fed to a cow per day. In general, it is a desirable practice to use at least two protein supplements in grain mixtures that are to be high in protein content. It is good practice to have approximately 1 per cent of salt in the grain mixture.

A STUDY OF ICE CHESTS

FAITH R. LANMAN

Many times the statement is made that families having low incomes cannot afford to buy refrigerators. The need for refrigeration, however, in even the most humble homes, is obvious. When there is no provision for keeping perishable foods, such as milk and meat, health is likely to be jeopardized and food to be wasted.

The use of small but properly constructed and insulated ice chests has been suggested as a means of meeting the situation. The matter of ascertaining the minimum requirements for them is of interest.

The brief study here reported was made to compare the temperatures maintained, the amount of ice melted, and the effect on the condition of certain foodstuffs in an ice chest having a 5/8-inch corkboard insulation with one having no special provision for insulation except that supplied by paper and a so-called "dead air space", as in ordinary ice chests on the market.

DESCRIPTION OF CHESTS

For this study two comparable, small ice chests were used. Both were sheathed with wood and were lined with galvanized iron. Each chest had two wooden racks, one for ice and one for food. There was a space of 1½ inches in the clear under the racks, thus permitting of air movement over the floor of each chest.

Inside dimensions of each chest were approximately 24¼ inches long, 16¼ inches wide, and 13⅝ inches deep. The lids were hinged in the center crosswise so that each end could be opened independently of the other. The lids were not fastened in any way to the chests. It was observed that in each case there was a slight space between the two halves of the lids. There was a drain in the floor of each chest.

The essential difference in these two chests consisted in the insulation. Chest No. 1 had 5/8 inch of corkboard between the inner and outer sheathings and Chest No. 2 had instead two sheets of paper.

SETTING UP THE EXPERIMENT

A removable drip pan was placed under the drain of each chest. The pans each had a fitted cover in which was a center bore with a small, tin funnel in it, so placed as to catch the drip.

In like positions, three tested thermometers were suspended in the left half of each chest, which was the part chosen for storing food during the experiment. Thermometer No. 1 was in a horizontal position 2 inches below the inner surface of the lid. Thermometer No. 2 was so located that the bulb was half way between the inner surface of the lid and the food rack and on a median line 6 inches from the left end of the chest. Thermometer No. 3 had its bulb at the food rack level at a point 3 inches to the left of the center of the chest.

The study was made in the month of August in Columbus, Ohio. The chests were placed side by side in a similar position with reference to exposure. Preliminary to making any observations as to the efficiency of the chests, similar pieces of solid ice weighing approximately 25 pounds each were placed one in each chest on the ice rack about 2 inches from the sides and 2 inches from the right ends. The chests were closed and allowed to cool for 17 hours.

ICE MELTAGE

At the end of a 17-hour period of cooling the remaining ice was removed, the drip pan was emptied, and a solid piece of ice weighing approximately 25 pounds and cut in the usual shape, 6¼″ x 11″ x 11″, was weighed and placed on the ice rack in each chest. At the end of each 24-hour period thereafter during the period of one week, the meltage was weighed, the ice remaining was weighed and removed, and as promptly as possible a new piece of ice cut to approximately the same shape and weight as the original charge was weighed and placed in each chest. The meltage of ice is indicated in Table 1. The difference in per cent of meltage shows that the chest insulated with ⅝ inch of corkboard consumed less ice than the other.

DETERMINATION OF TEMPERATURES

The thermometers in each chest were read and the temperature recorded three times each day, 9:00 A. M., 12:00 M., and 4:00 P. M. Room temperatures were also read and recorded at the same hours each day. The record of temperatures is shown in Table 1. As will be seen, the temperatures in Chest No. 1 which had cork insulation were continuously lower than those in Chest No. 2.

TABLE 1.—Record of Temperatures and Ice Meltage

All temperatures are in degrees Fahrenheit*

Day	Hour of taking temperature	Room temperature	Chest No. 1 Thermometers No. 1	Chest No. 1 Thermometers No. 2	Chest No. 1 Thermometers No. 3	Chest No. 1 Ice in chest Lb.	Chest No. 1 Ice in chest Oz.	Chest No. 1 Ice melted in 24 hours Lb.	Chest No. 1 Ice melted in 24 hours Oz.	Chest No. 1 Per cent of ice melted	Chest No. 2 Thermometers No. 1	Chest No. 2 Thermometers No. 2	Chest No. 2 Thermometers No. 3	Chest No. 2 Ice in chest Lb.	Chest No. 2 Ice in chest Oz.	Chest No. 2 Ice melted in 24 hours Lb.	Chest No. 2 Ice melted in 24 hours Oz.	Chest No. 2 Per cent of ice melted	Difference in per cent by which meltage in Chest No. 2 exceeded that in Chest No. 1
1st	4	84	60	50	44.6	27	9.0	......	.....	....	61	53.6	50	27	0.0	....	....	....	....
2nd	9	82	59	53.6	46.4	24	14.0	15	4.0	55.3	61	53.6	48.2	24	6.25	17	3.0	63.7	8.3
	12	82	58	51.8	44.6						59	52.7	47.3						
	4	82.5	58	51.8	44.6						60	53.6	48.2						
3rd	9	80	58	52.7	46.4	24	2.0	13	14.5	55.9	60	53.6	50.0	23	15.0	15	7.75	63.5	7.6
	12	80	56	50.0	43.7						58	51.8	47.3						
	4	80.5	58	50.9	44.6						59	53.6	48.2						
4th	9	83	62	55.4	48.2	24	11.5	14	1.0	58.3	65	59.0	52.7	24	6.0	15	12.0	65.8	7.5
	12	82	57	50.9	44.6						60	53.6	48.2						
	4	82	58	50.9	45.5						60	53.6	48.2						
5th	9	86	62	55.4	48.2	24	0.5	14	5.5	58.0	66	60.8	53.6	23	2.5	16	2.75	66.3	8.3
	12	83	58	51.8	45.0						60	54.0	49.1						
	4	83	58	51.8	45.0						60	53.6	48.2						
6th	9	86	62	55.4	49.1	24	9.0	14	7.3	60.1	66	59.9	54.0	25	2.5	15	15.5	68.9	8.8
	12	83	58	50.9	44.6						60	53.6	48.2						
	4	83	58	51.8	45.0						60.5	54.0	48.2						
7th	9	83.5	62	55.4	49.1	....	....	14	4.8	58.2	65	59.0	51.8	....	....	16	2.75	64.3	6.1
Av...	....	82.6	58.9	52.4	45.8	24.9 lb.		14.4 lb.		57.6	61.2	54.8	49.5	24.7 lb.		16.1 lb.		65.4	7.8

*Thermometers No. 2 and No. 3 in each case were calibrated on the Centigrade scale and the readings were interpreted in degrees Fahrenheit.

STORAGE OF LETTUCE

After the chests were cooled, two bunches of leaf lettuce similar in weight and quality were placed, one in each refrigerator in like positions on the food rack. Weight and condition of the lettuce were recorded at the end of each 24-hour period. As indicated in Table 2, the lettuce in the chest insulated with corkboard showed less shrinkage and remained usable for a longer period than the lettuce in the other chest.

STORAGE OF MILK

Each day for a period of one week, two one-pint samples of a good grade of pasteurized market milk were placed in like positions on the food rack in each ice chest. Bacterial counts obtained by plating were made on the milk at the time it was placed, and again at the end of 41-hour periods and at the end of 65-hour periods of storage. The bacterial counts and ratio of increase for each sample are shown in Table 3 and clearly indicate the influence of the lower temperature in Chest No. 1.

DISCUSSION

The accepted temperature for the care of milk in the home is below 45° F. Recently the same temperature has been fixed as desirable for fresh meat if it must be kept more than 2 days. For even one day's keeping, however, the temperature should be below 50° F.

Even with the small amount of insulation in Chest No. 1 the temperature in the lower portion, where milk, meat, and butter would ordinarily be kept, came encouragingly close to 45° F. during the experimental period, although the atmospheric temperature of the room ranged continuously from 80 to 86° F. During the same period and in a corresponding part of Chest No. 2 the temperature averaged 49.5° F. See Table 1.

In both chests observed, there was a difference of 12 to 13 degrees in the temperature at the food rack level and that just under the lid. It seems probable that the faults in construction of the lid were largely responsible for the fact that there was so great a difference.

TABLE 2.—Storage of Lettuce

Day	Chest No. 1				Chest No. 2			
	Average of readings of thermometer No. 3 Degrees F.	Weight of lettuce Grams	Per cent of loss	Appearance	Average of readings of thermometer No. 3 Degrees F.	Weight of lettuce Grams	Per cent of loss	Appearance
1st	44.6	254.0	....	....	50.0	254.0	....	....
2nd	45.2	237.0	6.6	Fresh and crisp.	47.9	237.0	5.6	Not quite so crisp as in Chest No. 1.
3rd	44.9	224.5	11.6	Slightly wilted, one leaf turning brown.	48.5	225.0	11.4	Similar to that in Chest No. 1.
4th	46.1	213.3	16.0	Few leaves turning brown.	49.7	212.6	16.3	Similar to that in Chest No. 1.
5th	46.1	204.0	19.6	All but outer leaves usable if freshened.	50.3	201.2	20.7	More wilted and leaves browner than in Chest No. 1.
6th	46.2	196.1	22.8	Inner leaves usable if freshened.	50.1	191.6	24.5	Not usable.

TABLE 3.—Storage of Milk

Days milk put into chests	Average atmospheric temperature Degrees F.	Chest No. 1						Chest No. 2					
		Average of readings of thermometer No. 3 Degrees F.	Bacterial count					Average of readings of thermometer No. 3 Degrees F.	Bacterial count				
			Original count per c. c.	After storage 41 hrs.		After storage 65 hrs.			Original count per c. c.	After storage 41 hrs.		After storage 65 hrs.	
				Count per c. c.	Ratio of increase	Count per c. c.	Ratio of increase			Count per c. c.	Ratio of increase	Count per c. c.	Ratio of increase
1st.......	84	44.6	10,300	12,600	1.2	240,000	23.3	50.0	7,000	30,000	4.3	770,000	110.0
			8,700	10,200	1.1	190,000	21.8		15,600	29,000	1.8	690,000	44.2
2nd......	82	45.2	4,700	10,500	2.2	550,000	117.0	47.9	5,300	22,600	4.2	1,480,000	279.2
			5,000	17,000	3.4	550,000	110.0		3,100	33,200	10.7	1,560,000	503.2
3rd.......	80.1	44.9	650	32,000	49.2	880,000	1353.8	48.5	5,500	100,000	18.2	650,000	118.2
			2,000	50,000	25.0	830,000	415.0		4,000	100,000	25.0	3,750,000	937.5
4th.......	82.3	46.1	1,100	7,300	6.6	160,000	145.4	49.7	300	16,000	53.3	680,000	2666.6
			400	6,400	16.0	140,000	350.0		2,700	30,000	11.1	850,000	314.7
Average ratio of increase in bacterial counts				....	13.08	....	317.03	....	....	....	16.07	....	621.7

CONCLUSIONS

The greater efficiency of the insulated chest as compared with the one having paper and air space was shown by difference in (1) per cent of ice melted, (2) temperatures within the chests, (3) the ratio of increase in bacterial count of milk stored, and (4) the changes in condition of lettuce stored. In every respect the insulated chest was the better.

It is encouraging to observe that even so small an amount of insulator as was used in Chest No. 1 made so great a difference in performance and points to the probability that the use of an insulator one inch in thickness would improve performance still further. With such insulation a chest built and marketed at a price within the reach of families of low incomes could be used to great advantage because of low ice meltage, reduction of food waste, and protection of health.

Those interested in further information on household refrigeration may be interested in the following publications:

Bureau of Home Economics, U. S. D. A. Household Refrigeration Charts No. 1 and No. 5.

Milk in the Household Refrigerator, by A. M. Pabst, Bureau of Home Economics, U. S. D. A. Published in Ice and Refrigeration, January 1929.

Meat Keeping in Home Refrigerators, by A. M. Pabst, Bureau of Home Economics, U. S. D. A. Year Book 1931, page 369.

Bulletins on Household Refrigeration, by M. E. Pennington, Household Refrigeration Bureau, 51 Chambers Street, New York City.

A PRACTICAL UNDERGROUND STORAGE

DONALD COMIN

The grower of vegetables and fruits can appreciate the advantages of a cool storage room in which to hold his perishable produce for varying lengths of time. During the growing season the market is often temporarily over supplied, and a storage will carry some of the crop through this trying period.

On a small scale, storage space lengthens the farmer's fresh-food supply, prevents wasting the surplus yield from the farm garden, and provides a place in which to hold almost all perishables until they can be disposed of more conveniently. Such a storage

has particular advantages when used in connection with a road-side market. The use of such facilities is obviously a necessity in the case of the commercial grower of late-keeping fruits and vegetables.

The accompanying plans for the construction of an adequate but inexpensive, underground, concrete storage have been prepared to show the possibility of using facilities already at hand.

Fig. 1.—The barn approach is a convenient place for an underground vegetable storage

Storage possibilities.—Existing spaces in barns and barn cellars may be utilized for storing perishables after slight alterations are made in their wall construction and ventilation. The principles of common air-cooled storages are the same regardless of the size of the storage or the crop to be stored, although special precautions in construction and ventilation are often practiced when some single crop, whose specific requirements are known, is to be stored.

The following suggestions are confined to the underground type of storage since this type is most practical for general storage.

Ground controls storage temperature.—All perishable-produce storages require a certain amount of insulation in the walls to prevent rapid temperature changes. Above-ground storages must employ more or less costly materials for insulation. Fortunately, the earth provides a simple means of meeting this problem when low temperatures are not necessary. Soil, especially damp earth, is a poor insulation against the flow of heat, but, by virtue of its

tremendous thermal capacity, it has a modifying influence on the temperature of the surrounding air. It acts constantly as a huge reservoir of thermal (heat) units and tends to maintain the temperature of the storage close to that of the earth (40° to 55° F.).

During the summer and early fall the earth temperature is lower than that of the air, and it absorbs heat and cools the storage air. During the late fall and winter it is warmer than the outside air and releases heat to the storage. Thus, the modifying tendency of the earth on the incoming storage air takes the place of insulation in storages built entirely above ground.

Dirt floors maintain desired humidity.—It is already well known that the natural water movement taking place in the soil maintains a desirable humidity in such storages at all times. Incidentally, the water evaporation that is constantly taking place tends to cool, directly or indirectly, to a certain degree, the stored produce.

Maximum ventilation with minimum temperature change.—The underground storage affords ideal conditions for those perishables demanding considerable ventilation. Incoming cold air will remove the heat from stored produce with a rapidity depending upon the volume of air passing through the storage during a given time, as well as the difference in temperature of the air and produce. At the same time, the earth floor and walls have the capacity to raise or lower the temperature of the ventilating air all day long with hardly any appreciable effect on the soil temperature. The result of these forces is to lower the temperature of the stored product rather rapidly while the ventilators are open, providing the air temperature is sufficiently low. When the ventilators are closed, the temperature inside gradually returns to that of the ground and any frost injury is prevented. The great capacity of the earth to moderate incoming air temperatures allows for maximum air ventilation with the minimum danger from too rapid temperature lowering within the storage.

Perishables, such as some varieties of apples, which are stored best at temperatures close to 35° F., may be kept to a better advantage in well insulated, above-ground storages. This requirement does not preclude the possibility of storing such fruits in underground structures with considerable satisfaction.

The limitations of this type of storage should not be underestimated, and it should be emphasized that the above-ground storage offers some advantages, particularly during seasons of mild temperatures. During seasons when low air temperatures arrive early, it is possible to lower the temperature of produce stored

below ground and to maintain this temperature easily against the counteracting higher temperature of the earth. Difficulties arise during those seasons of persistent high temperatures that are partially overcome with the above-ground storage.

Location for the storage.—Underground or partially underground storages are usually located in a bank or hillside. When such locations are not available, or for purposes of convenience, the elevated approach to a barn may be utilized. This site is usually situated at the center of farm operations.

It is often selected because of the minimum excavation required in preparation for construction. In addition, the barn wall may serve as one wall of the storage and reduce costs accordingly. It is an advantage so to place the structure in regard to the points of the compass as to utilize fully the prevailing winds as an aid in ventilation. The matter of drainage should also be considered in locating the storage.

CONSTRUCTING THE EXPERIMENT STATION STORAGE

The storage described in the following paragraphs was constructed on the Station Farm during the fall of 1930. It is being used in storage studies with vegetables. The construction plans, photographs, specifications, and description of methods are presented not as a standard but as suggestions which may be incorporated in other plans.

A convenient location.—No hill or bank being available on the grounds, the raised approach to a two-story barn was selected as a site for this storage (Fig. 1). This location was at the center of horticultural operations, minimized the problem of excavation, and provided protection from the heat of the sun since it is on the north side of the barn.

Farm tools used in excavation.—Next to the barn a 12- by 54-foot section of the approach to the barn was removed with the aid of a team and scraper. A minimum of hand labor was necessary to straighten the single earth wall in preparation for placing the forms (Fig. 3). Under the existing conditions, which were far from favorable due to the debris found within the approach, the excavation required 86 team and 263 man hours to complete.

Lumber on the farm used in forms.—Rough, used lumber was utilized in the construction of the forms. Cut lengths of 6-inch saplings obtained from the farm woods were used as supporting timbers. The lumber and its method of use are shown in Figure 3.

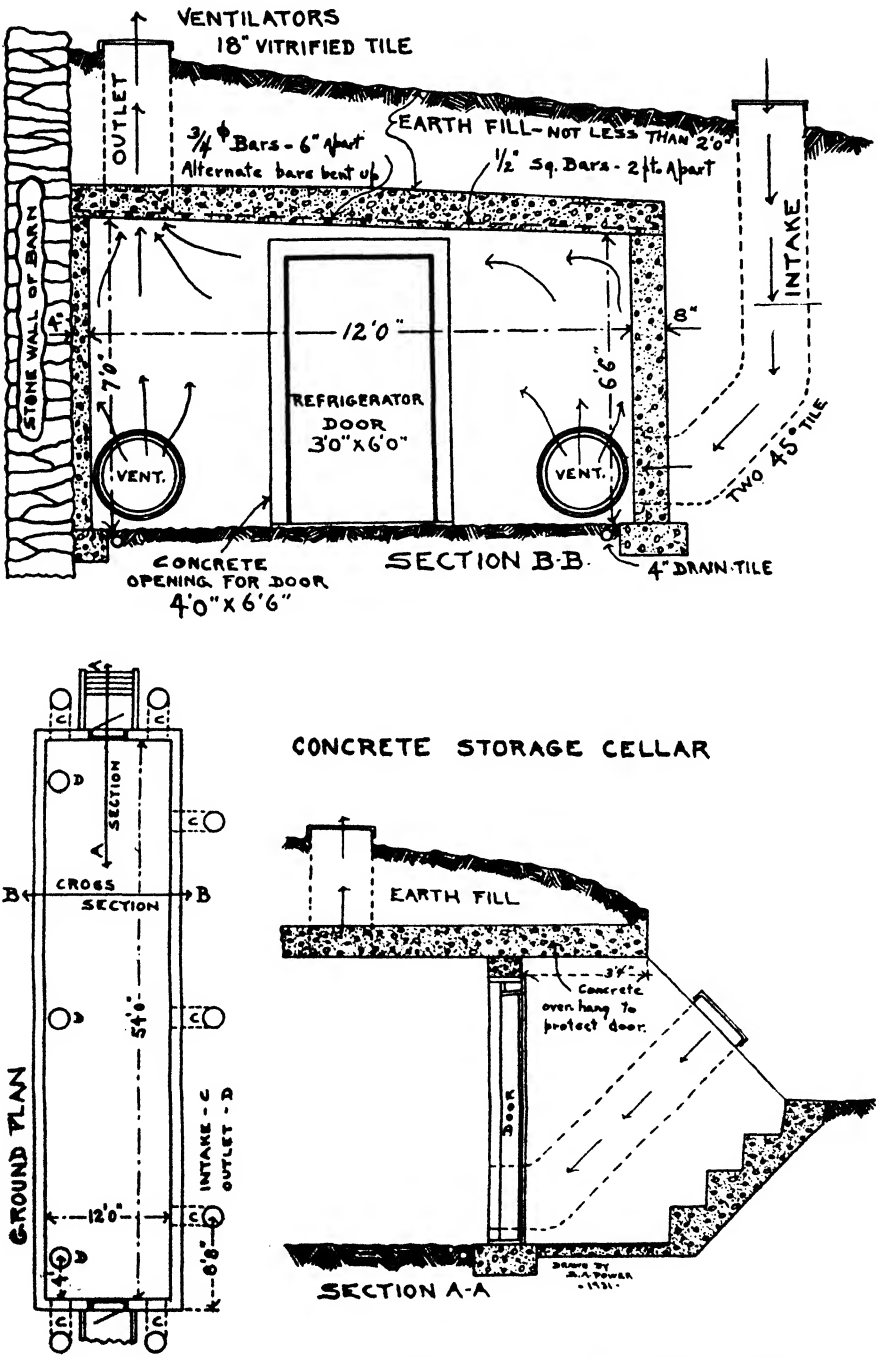


Fig. 2.—Construction details of Storage Cellar at the Ohio Station

The earth wall on the north side and the stone foundation of the barn on the south eliminated several forms. The concrete for the walls was poured, and, after taking an initial set (over night), the forms were removed and reconstructed to support the roof slab. In this manner the amount of form material needed was greatly reduced.

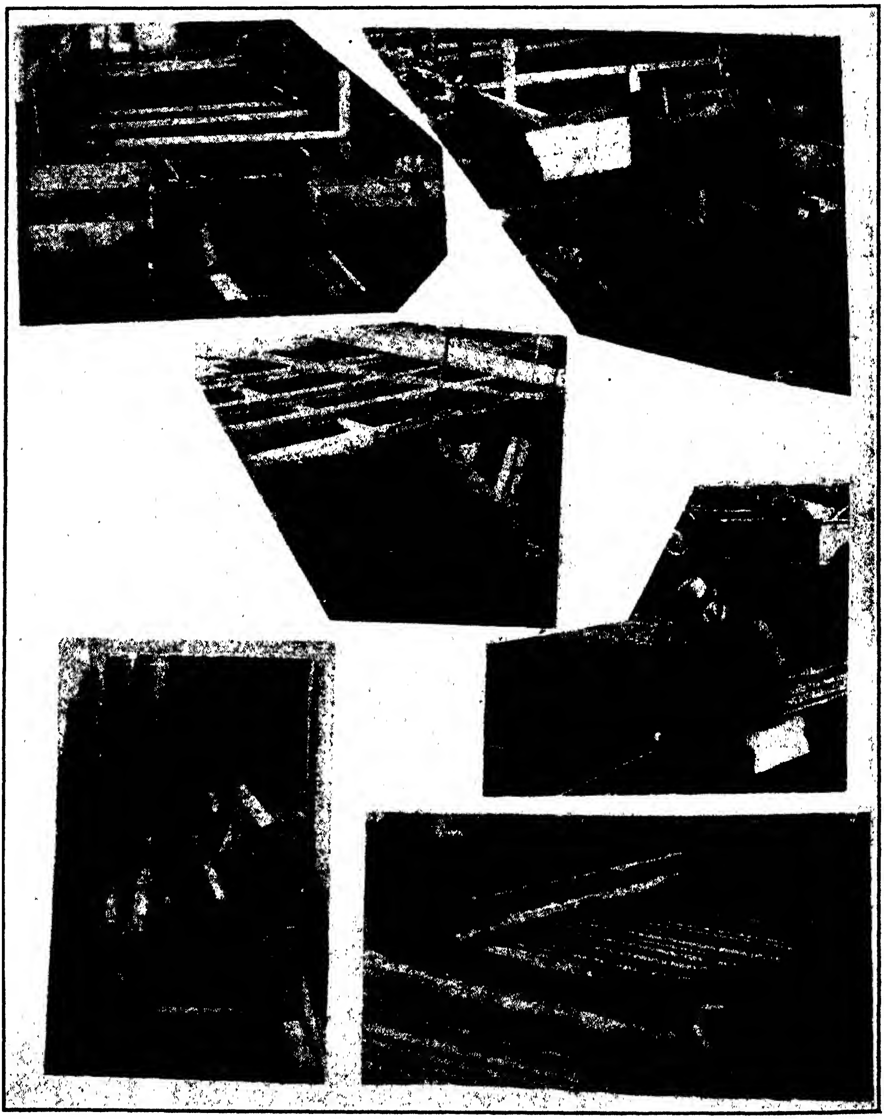


Fig. 3.—Placement of forms and construction steel preparatory to pouring concrete

Concrete poured of local gravel.—The walls and footings were poured of a lean concrete made of one part of cement to six parts of bank-run gravel. The roof slab required a stronger mixture of one to three. Some used brick and stone were thrown in with the concrete. A thin layer of heated road tar was brushed on the finished roof slab as waterproofing.

Reinforcement depends upon load.—The walls and footings required no reinforcement. The roof slab was necessarily reinforced with construction steel since truck loads of 5 tons or more pass over this barn approach. Accepted practices and plans of reinforcement, as supplied by construction steel manufacturers, were followed. See Figure 3 for details of construction and Table 1 for quantities and costs.

TABLE 1.—Vegetable and Fruit Storage
Bill of materials for actual purchases

		Dollars
Cement	250 sacks	187.50
Gravel—bank-run	53 cubic yards	86.65
Reinforcement steel	108 ¾-in. bars, 1367 ft. (round) 16 ½-in. bars, 448 ft. (square) Total 2597 lb.	103.88
Sewer pipe—18-in. tile	33 pieces	46.20
Tar—road	1 barrel	7.50
Cold storage doors—3 ft. x 6 ft.	2 pieces	72.09
Electric fan—20-in. exhaust	1 piece	55.00
Total		558.82

Ample ventilation provided by doors and tile openings.—One door opening was placed in each end of the storage. This provided one square foot of door area for each 117 cubic feet of storage volume. Under normal conditions this would probably prove ample for ventilation purposes. Commercial, cold-storage doors were installed as they were found to be most satisfactory and as economical as an equal protection by other means.

Seven inlet and three outlet ducts were put in place as means for additional ventilation (Fig. 4). They will be used to supplement ventilation through the doors and at night when the doors are locked. Vitrified, 18-inch, sewer pipe tile, purchased as seconds, were used for this purpose, since they are inexpensive and have proved satisfactory in other installations. Their location and number may be varied to suit individual conditions. The number used in this storage may be excessive although they will insure adequate ventilation under any condition and will prevent dead air pockets forming in the corners and elsewhere. The air-intake area equals one square foot for every 340 cubic feet of storage capacity;

the out-takes, one square foot to 794 cubic feet. By installing out-take flues of greater number and length or an exhaust fan or other contrivance to aid air movement, the ratio of vent size to storage capacity could have been materially raised.

A one-twentieth horse-power, airplane-propeller-type, exhaust fan with 105-watt electrical in-put was installed in this storage. At prevailing current costs this fan will effect 25 complete air changes per hour at a cost of less than one cent.

Well drained earth floor essential.—The dirt floor in this storage is expected to maintain a relative air humidity satisfactory for the storage of any vegetable or fruit. A wooden-slatted floor may be installed, if found desirable. A line of 4-inch drainage tile was laid just below ground level inside the storage at its periphery. The line was connected with drain openings in front of each door and empties into a nearby ditch. The tiles were covered with a thin layer of cinders.

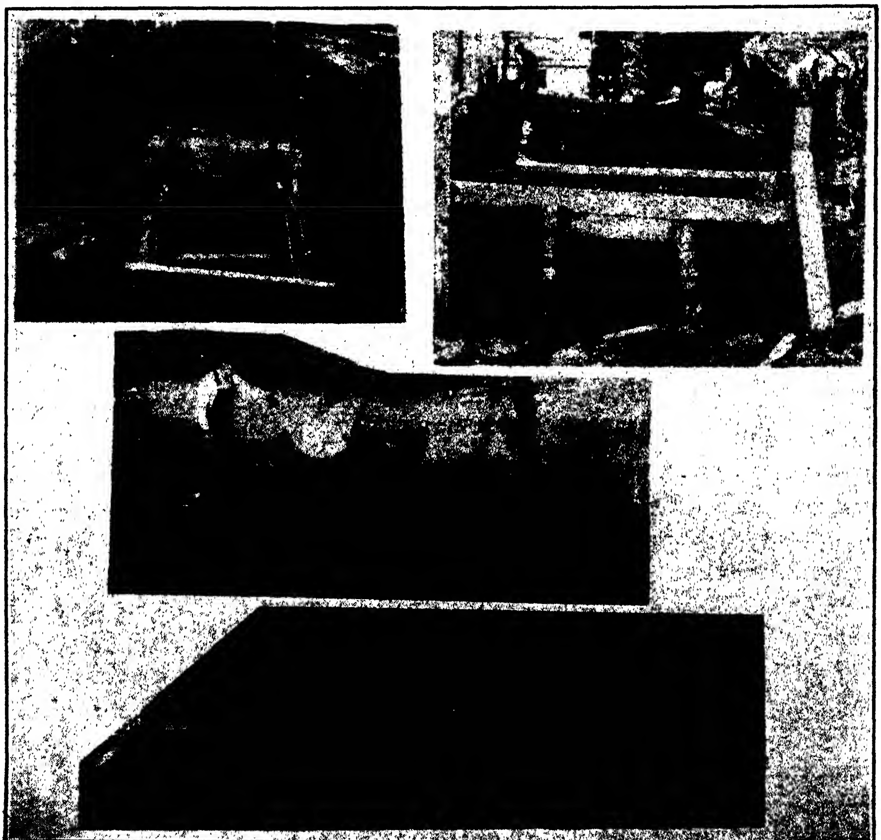


Fig. 4.—Completing roof-slab and covering with earth and sod

Soil and sod exterior cover.—The completed storage has a minimum of 2 feet of earth fill, covered with sod, on the roof and ends. This fill will prevent the entrance of frost through the roof slab, and the sod will present a pleasing appearance to the exterior, as well as favoring low temperature beneath (Fig. 4).

The tile vents coming to the surface of the ground have strong wooden and metal covers which are uninjured by horse or truck. Coarse-mesh screens in all openings prevent rodents or trash from entering while the storage is being ventilated at night. Home-made, padded plugs fit into the tile openings from the inside and prevent air leakage during sub-zero weather.

CONCLUSIONS

This storage should especially commend itself to the general farmer who has small quantities of perishable crops and is not justified in making much of an expenditure for storage. Its material cost is low and it can be constructed with the equipment and labor found on the average farm. The small investment would likely be paid for from savings to be secured by such storage facilities.

SOURCES OF IRISH COBBLER SEED POTATOES

JOHN BUSHNELL

Early potatoes are an important crop in several counties of southern Ohio. Irish Cobbler is today the leading variety. The entire crop is commonly sold as soon as harvested in midsummer, as most growers have found that home-grown, spring-crop potatoes are not suitable for seed. Most of the acreage is therefore planted with potatoes obtained from the North.

Certified Irish Cobbler seed potatoes are grown in large quantities in Prince Edward Island, Maine, New York, Wisconsin, Minnesota, and North Dakota, and to a lesser extent in Michigan. Ohio is so geographically situated that seed is received from all these districts, and the competition is often keen between sales agents. Moreover, there is frequently a price difference, seed from the western group of states being at times quoted lower than that from the East.

Ohio growers seeking the best certified seed are naturally inclined to favor the higher priced seed, on the logical assumption that in a competitive market only seed which has proved superior could command a premium. As a matter of fact, there is very little evidence that certified Irish Cobblers from one district actually produce higher yields than those from another. The price is based upon the appearance of the seed rather than upon its past performance. Certified seed as it comes to Ohio from Prince Edward Island is skillfully graded and very attractive, as likewise is much of that from Maine and Michigan. New York seed is characteristically less carefully graded; while that from the western group of states is not only poorly graded, as a rule, but is frequently spotted with Rhizoctonia.

To determine the relative yielding capacity of the certified seed from various sources, irrespective of its appearance, comparisons have been conducted at the Washington County Truck Station, near Marietta. Samples were solicited from sales agencies, some were obtained from dealers in Marietta, and some directly from well-known seed producers. An attempt was made to secure samples representing the best from each district. The dealers and agencies listed below have generously and enthusiastically submitted samples for these comparisons:

New York Cooperative Seed Potato Association, Utica, N. Y.
Woodman Potato Co., Washburn, Maine—represented in Ohio by Thos. B. Buell, of Elmira, Mich.
Michigan Potato Exchange, Cadillac, Mich.
Albert Miller Co., Chicago—handling seed from Wisconsin and North Dakota.
Red River Certified Seed Co., Moorhead, Minn.
Weber Grocery Co., Marietta, Ohio.

RESULTS OF THREE SEASONS' TESTING

During the period that the Irish Cobbler was rapidly supplanting the Early Ohio, most of the certified seed for Ohio was obtained from the Wisconsin-Minnesota-North Dakota region where both varieties were produced on a large scale. By 1929, when comparisons were started at the Truck Station near Marietta, the Irish Cobbler had become more popular than the Early Ohio, and certified seed was being obtained from Michigan and the eastern districts as well.

The preliminary test in 1929 aimed to compare seed from North Dakota with that from Michigan and Prince Edward Island. Unfortunately, the samples from Prince Edward Island did not

arrive in time to be planted in Washington County. The yields from the North Dakota and Michigan lots averaged about the same, as shown in Table 1.

TABLE 1.—Yield in Bushels per Acre from Samples of Certified Irish Cobblers
Single rows, without replications—1929

Sample from:	Yield at Marietta			Yield at Wooster		
	Grade 1*	Small	Total	Grade 1	Small	Total
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
Michigan 1	474	42	516	134	18	152
2	385	41	426	129	18	147
3	294	34	328	133	21	154
Average of Michigan samples	384	....	423	132	....	151
North Dakota 1	387	50	437	....	....	....
2	363	46	409	....	....	....
3	357	53	410	....	....	....
Average of North Dakota samples	369	....	419	....	....	....
Minnesota	....	....	....	118	23	141
Prince Edward Island	....	....	....	109	16	125

*Grade 1 is U. S. No. 1.

Part of each of the samples from Michigan were planted later at Wooster to compare them with a sample from Prince Edward Island and with one from Minnesota. The Michigan samples gave the highest yields. No diseases were conspicuous in any sample in either test, and in general appearance the plots were remarkably uniform.

In 1930, eleven samples were compared. Planting was in triplicated rows to give greater accuracy to the yield records than was obtained from the single rows of the preceding year. The drouth of 1930 was particularly severe at Marietta, prematurely ripening the potatoes and reducing the yield. The results are given in Table 2.

TABLE 2.—Bushels per Acre of Salable Potatoes, Including Small Sizes, Marietta—1930

Sample from:	Yield	Sample from:	Yield
	Bu.		*Bu.*
New York 1	110	Prince Edward Island	87
2	84	Maine	86
		Wisconsin	75
Michigan 1	107	Minnesota	66
2	88		

The test was continued on the same plan at Marietta in 1931. Part of the work was duplicated at Columbus by E. B. Tussing, of the Agricultural Extension Service. His samples were secured independently but, in most instances, from the same dealers who furnished the Marietta samples. At Marietta the lots from New York, Michigan, and Maine showed up well, giving higher yields than those from Minnesota, Wisconsin, or Prince Edward Island. At Columbus, the plots were injured by a severe freeze in late May, which reduced the yields and may have set back the advanced lots more than others. The samples from New York varied widely, one giving the highest and another the lowest yield. The sample from Wisconsin stood second.

TABLE 3.—Average Yield in Bushels per Acre from Triplicated Rows—1931

Samples from:	Yield at Marietta			Yield at Columbus		
	Grade 1	Small	Total	Grade 1	Small	Total
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
New York 1	324	51	375	142	33	175
New York 2	302	46	348	120	28	148
New York 3	297	52	249	99	35	134
New York 4	313	50	363	.....	.....	.....
New York 5	320	42	362	.....	.....	.....
Michigan	316	48	364	.....	.....	.....
Maine	310	41	354	108	29	137
Prince Edward Island	271	51	322	110	34	144
Wisconsin	269	53	322	132	28	160
North Dakota	.....	.....	.....	116	29	145
Minnesota	250	42	292	.....	.....	.....

TABLE 4.—Summary of Average Yield of Samples from Each State or Province

Bushels per acre of Grade 1 potatoes

Samples from:	1929 Marietta		1929 Wooster		1930 Marietta		1931 Marietta		1931 Columbus	
	No.	Yield	No.	Yield	No.	Yield*	No.	Yield	No.	Yield
		Bu.		*Bu.*		*Bu.*		*Bu.*		*Bu.*
Michigan	2	384	3	151	2	98	1	316	.....	.....
New York	.....	.....	.....	.....	2	97	6	311	3	120
Maine	.....	.....	.....	.....	1	86	1	310	1	108
Prince Edward Island	.....	.....	1	135	1	87	1	271	1	110
North Dakota	3	369	.....	.....	2	91	.....	.....	1	116
Minnesota	.....	.....	1	141	1	66	1	250	.....	.....
Wisconsin	.....	.....	.....	.....	1	75	1	269	1	132
Average of all samples	6	377	5	146	10	89	11	300	7	121

*Total yield instead of grade No. 1.

The 3 years' data are summarized in Table 4 by comparing the average yield of Grade 1 potatoes from each state or province with the average of all certified samples. In this condensed tabulation the seed from Michigan and New York stand out as above the average.

Fig. 1.—Excellent stands and uniform growth from samples of certified Irish Cobblers in plots at Marietta, June 12, 1931

PRECAUTIONS AND RECOMMENDATIONS

In comparisons such as these where very few samples are used, there is always the chance that the lots tested do not truly represent certified seed from the various sources. The results cannot be used as a basis for conclusive generalizations. For the present, however, it is of value to know that all of the samples tested were practically free from disease, gave excellent stands, and that the highest yielding ones in each test were from Michigan or New York.

Rhizoctonia was present on most of the samples from the West. These were planted without treatment for this disease, and it was surprising that none developed noticeably during the growing season. The practice of planting untreated seed which is coated with Rhizoctonia is not advocated from this experience, however. It is obviously safer to use uninfected seed, and this can be obtained from Michigan and the eastern sources. Clean seed does not need treatment before planting.

The reasons for the differences in yield are as yet unknown. Since they cannot be attributed to disease, they must be sought in the growth and storage conditions. It must be remembered that growth and storage conditions vary within any given district, and samples from even a limited locality will vary in yielding capacity. This is well illustrated in the results obtained in these tests from samples of a single state.

In conclusion, it must be restated that the appearance of a sample of seed potatoes is not an index to its capacity to produce high yields. The clean, attractive, uniform samples were in some instances below, and in other instances above, the average in yield in these comparisons. If a premium in price is demanded for Irish Cobbler seed potatoes, it should be based upon a reputation for producing high yields rather than upon appearance.

HOME-GROWN SEED

A few bushels of the potatoes grown in the Marietta plots were placed in an ordinary cellar storage and kept well. At planting time the following spring they were more wilted and sprouted than the certified potatoes received from the North, but they grew well when planted. Such seed characteristically produces more sprouts per seed piece and, consequently, more tubers per hill than northern seed. The total yields in two tests were about equal to those of the certified samples, but there was a larger proportion of small tubers from the home-grown seed. These results suggest that spring-crop Irish Cobblers might be suitable for seed, if special attention were given to storage. Growers who wish to try this practice are advised to consider it as an experiment, remembering that it has not proved successful in other early-potato districts.

FORCING PLANTS WITH ARTIFICIAL LIGHT

ALEX LAURIE AND G. H. POESCH

Since light is one of the great limiting factors in forcing flowering plants in the greenhouse during the winter, particularly where long-day crops are concerned, a series of tests, using additional artificial illumination, was conducted upon 70 different kinds of plants during the past season. Artificial light was applied through the use of 75- and 100-watt, clear-glass lamps. Previous experimental work depended upon high-wattage lighting, which made commercial practices too expensive. The lower wattage employed in the tests described does not make the costs prohibitive.

The method of application was simple. A series of eight to ten sockets was attached to a cord, which was so arranged that as the plants grew the lights could be raised. These were evenly distrib-

uted, and each covered approximately 12 to 15 square feet of bench space. Where the lower wattage lamps were used the distance between them was reduced.

The time and length of application were determined during previous tests. The light was turned on at 6 P. M. and turned off at 10 P. M. This gave the plants 4 hours of added illumination per day.

The cost of electricity was based on local light rates of 3 cents per kilowatt hour.

RESULTS

Potted plants.—Calceolaria reacted very favorably to added illumination. The plants were placed under test November 12 and, under added illumination, flowered February 12. The checks were in flower 42 days later, or March 26. The cost of added light was 9 cents per plant for the entire period.

Dutch Iris, variety Wedgewood, was placed under added illumination December 13 and flowered March 2. No great difference in time of flowering was noted. Those under added light produced 97 per cent bloom; whereas those in the check plots gave 47 per cent, showing a difference of 50 per cent in favor of additional light. The stem length was 3.5 inches longer under additional light.

Cyclamen and Primroses both responded to the light treatment, but the differences secured do not warrant the installation. However, backward plants may warrant additional light if it is applied for at least 4 weeks before the plants are needed for sale.

Cinerarias responded to the addition of light. They flowered from 8 to 20 days in advance of the check plants. Muscari (Grape Hyacinth) produced one spike per bulb more under light, as compared with the check; the stem length was 1.5 inches in favor of added light. Freesias reacted unfavorably to additional light.

Bench crops.—Carnation, var. White Matchless, was given additional light, using 150-watt bulbs, from November 4 to April 9. The results were as follows:

	Flowers per plant	Av. stem length	Av. flower diameter
	Number	*Inches*	*Inches*
Light	8.14	19.43	2.52
Check	6.90	18.85	2.53

The increase in production under the additional light was from March 15 to May 15. After that time the check plot gained rapidly. The results show that a slight increase may be expected, but the

greatest benefit derived from additional light is earliness. The cost of obtaining the additional 1.24 flowers per plant was 6.4 cents.

Annuals.—A number of annuals were sown September 25 and benched December 4. Each plot received 4 hours of additional illumination. Ten 150-watt lamps covered 157 square feet of bench space. These were placed 4 feet apart and 15 inches above the plants and were raised from time to time as the plants grew taller. The results are given in Table 1.

TABLE 1.—Effect of Artificial Light on the Flowering of Annuals

Plant	Check			Light			Diff. in flower-ing days	Cost per sq. ft.	Cost per flow-er
	Av. flowers per plant	Av. stem length	Date of flower-ing	Av. flowers per plant	Av. stem length	Date of flower-ing			
	Number	*Inches*		*Number*	*Inches*			*Cts.*	*Cts.*
Annual chrysanthemum	20.8	12.4	May 9	33.0	11.7	Apr. 19	20	8.8	.26
Calendula	10.3	11.2	Feb. 17	9.7	11.7	Feb. 17	....	8 8	.9
Calliopsis	....	....	May 12	....	....	Mar. 21	52	8.8	.006
Candytuft	9.3	19.4	May 18	9.2	16.5	Apr. 20	28	8.8	.9
Centaurea cyanus	123.2	8.3	Apr. 25	76.6	11.8	Mar. 17	39	7.2	.009
Centaurea imperialis	16.2	14.1	Apr. 23	60.4	12.7	Apr. 7	46	8.8	.14
Cynoglossum	9.1	13.4	May 9	2.7	18.4	Apr. 13	26	8.8	3.1
Didiscus	30.6	9.1	May 9	27.9	10.1	Apr. 14	25	8 8	.31
Feverfew	9.7	28.8	May 28	13.2	12.1	Apr. 1	57	8.3	.62
Annual larkspur	15.0	23.4	Apr. 7	18.4	21.2	Apr. 3	4	8 8	.47
Marigold	2.5	7.4	Apr. 16	3.5	12.2	Apr. 16	....	8.8	2.5
Salpiglossis	3.8	35.6	May 12	2.4	30 0	Apr. 20	22	8.8	3.6
Scabiosa	21.9	12.0	June 8	45.5	14.6	May 6	33	8.8	.19
Schizanthus	18.0	19.5	Feb. 28	14.1	18.5	Jan. 28	31	3.4	.24
Snapdragon, Cheviot Maid	5.6	22.9	Mar. 21	3.6	20.3	Mar. 6	15	6.5	1.8

Many of the annuals responded to the additional light. The practicability of the use of this additional light commercially depends upon the factor of cost. Under the tests conducted the additional expense for the electric current was 3.4 cents per square foot per 30-day month. This cost is low. Feverfew may be used as an illustration. The additional cost of added light in the case of this crop is 8.3 cents per plant for the entire length of application, and the cost for each individual flowering stem is only .6 of a cent. This slight additional expense is more than balanced by the higher price secured, due to the earliness of the crop so produced, particularly since it is marketed at a time when such flowers are not available under ordinary conditions of culture. The annuals which would pay commercially are: Centaurea cyanus, Centaurea imperialis, Scabiosa, Didiscus, Schizanthus, Feverfew, Annual Chrysanthemum, and Salpiglossis.

Herbaceous perennials.—Another test to determine the value of additional illumination was tried on a variety of perennials. The plants were removed from the field and placed in a greenhouse at 50° F. on January 6. Eighteen 75-watt lamps were used and covered 200 square feet. The results are given in Table 2.

TABLE 2.—Effect of Artificial Light on the Flowering of Herbaceous Perennials

Crop	Check			Light			Difference in flowering days	Cost per sq. ft.	Cost per flower
	Av. no. flowers per plant	Av. stem length	Date of flowering	Av. no. flowers per plant	Av. stem length	Date of flowering			
		Inches			*Inches*			*Cents*	*Cents*
Achillea	24.1	19.1	May 9	15.0	21.9	Apr. 7	29	7	.46
Coreopsis	102.5	13.0	May 21	146.4	13.0	Apr. 20	31	7	.05
Delphinium	2.2	22.8	Apr. 23	2.5	24.1	Apr. 14	9	7	2.8
Gaillardia	8.4	12.1	May 11	41.2	13.9	Apr. 2	39	7	.16
Pansy	28.7	....	Feb. 20	44.2	....	Feb. 20	....	7	.15
Shasta Daisy	7.4	15.8	Apr. 13	10.4	15.5	Mar. 17	27	5.3	.5

It can be seen readily that Coreopsis grown indoors without artificial light flowered only a few days earlier than those grown out-of-doors; whereas those grown indoors under added light flowered 31 days in advance of the check. The cost per flower was only .05 cents. Pansies flowered more freely under light, producing 36 per cent more flowers, superior in quality and in length of stem.

Coreopsis, Gaillardia, Pansy, and Shasta Daisy were the best of the herbaceous perennials subjected to artificial illumination. Two-year-old field-grown plants were used for forcing.

The commercial value of electric light for forcing Gladiolus is questionable. Three separate plantings were made: October 25, November 15, and December 13. The corms were harvested early in the summer and were in good planting condition for the first planting. One hundred and fifty-watt lamps were used and were turned on when the spikes reached a height of 4 inches. Table 3 indicates the effect of additional light upon gladiolus.

The cost of using electric light for Gladiolus is too high for commercial purposes. Only three of the eight varieties responded to this treatment; namely, Coleman, Virginia, and Los Angeles. In general, however, the slight increase in production of gladiolus is not sufficient to equal the cost of electricity, since comparatively little difference in earliness of the crop was secured.

TABLE 3.—Effect of Additional Light Upon Gladiolus

Crop	Check			Light		
	First planting	Second planting	Third planting	First planting	Second planting	Third planting
	Percentage of flowers					
Coleman	55	90	35	95	95	75
Halley	10	30	90	20	10	75
Los Angeles	0	38	....	77	60	....
Myrtle	0	60	50	70	25	50
Peachblossom	....	205	....	....	180	....
Pendleton	75	95	70	70	80	40
Sunbeam	115	115	75	105	115	110
Virginia	5	25	55	75	120	85

SUMMARY

1. The addition of electric light for a 4-hour period, from 6 P. M. to 10 P. M., is warranted upon certain flowering plants and cut-flower crops.

2. The crops benefited are: *Plants*—Calceolaria, Cineraria, Spanish Iris; *Cut Flowers*—Centaurea cyanus, Centaurea imperialis, Scabiosa, Didiscus, Schizanthus, Feverfew, Annual Chrysanthemum, Salpiglossis, Coreopsis, Gaillardia, Shasta Daisy, Pansy.

3. Earliness of production and resultant higher prices are secured through the added light, the cost of which, per flower, is small.

FACTORS AFFECTING NITRATES IN SOILS

J. W. AMES

Variations in the nitrate content of soils are due to a number of conditions affecting nitrate production and removal. Supplying nitrogenous organic material, in the form of green manures, farm manures, and crop residues, and the addition of lime are considered to be important factors influencing nitrate production. It has been rather definitely established that maximum nitrification in soil also depends upon proper temperature and moisture conditions and aeration. Aside from removal by crops and leaching, nitrate nitrogen in field soils can be decreased by denitrification and by utilization by certain soil micro-organisms.

Nitrates found in differently treated soils from plots of certain fertility experiments of the Agronomy Department at the Ohio Experiment Station exhibit variations that are due to a greater

extent to seasonal weather conditions and cropping than to the soil treatment. For 4 years the nitrate content of plots included in a "crop-residue" project was determined at intervals during the period the land was in corn. Nitrates were also determined in soil from plots of the so-called "legume-reaction" experiment in 1931.

SAMPLING PROCEDURE

Samples of soil from crop-residue plots were obtained from 22 individual locations between the five corn rows, 42 inches apart, on plats 16 feet wide by 136.12 feet long and having an area of 1/20 acre. No samples were taken from the area between outside rows and the edges of plots. According to this plan of sampling, the location of the first borings between two rows was 6 feet from the end of the plot and in the two alternate rows 12 feet from the end. The sampling locations were uniformly distributed 25 feet apart over the length of the plot and 7 feet apart crosswise. When the samples were taken close to corn hills the locations were 4 inches from the hills. Nitrates were determined in rapidly dried soil by reduction and distillation, using Devarda's alloy as the reducing agent.

VARIATION IN SAME PLOT

To determine how accurately the nitrates in soil obtained by this method of sampling represented the actual nitrate content of the entire plot, nitrates were determined in each of 22 individual samples from a given plot. The results in Table 1 show that there were wide variations in the nitrate content of soil from the individual locations. The mean for separate samples agrees closely with the nitrate content found in a composite of the 22 samples. This indicates that the nitrate content, as determined, closely represents the actual amount present in the soil of a 1/20-acre plot.[1] The considerable variation in nitrates of individual samples emphasizes the necessity of taking a large number of samples in order to obtain a fairly accurate invoice of the nitrate supply of a given area.

VARIATION IN RELATION TO DISTANCE FROM CORN HILLS

During the season of 1928 nitrates in soil under corn were determined from locations midway between corn rows and from locations adjacent to corn hills. Table 2 shows the distribution of

[1] The mean of 22 separate samples was 29.81 $\pm$ 1.64, the standard deviation was 11.42 $\pm$ 1.16. The nitrate content of a composite of the 22 samples, as determined, was 29.88 lb.

nitrates in soil from these locations on August 10 and 24. Larger amounts were found in soil 24 inches from the corn, as compared with the nitrate accumulation at a distance of 4 inches. It is evident from the greater accumulation in the soil between the rows at the greater distance from the corn that assimilation by the growing corn from the more restricted area close to the plants has lowered the nitrate level appreciably. A similar variation in soil nitrates at different locations with respect to distance from corn hills occurred in soil under corn during the season of 1930. A comparison of the nitrate accumulation in soil between rows and near corn hills for 1930 is given in Table 3.

TABLE 1.—Variation in Nitrate Content of 22 Individual Samples from the Same Plot

Nitrate nitrogen, pounds per acre—2 million pounds dry soil

Location number	Pounds per acre
1	37.36
2	32.76
3	26.46
4	28.38
5	30.24
6	27.56
7	32.04
8	27.16
9	18.52
10	32.60
11	22.62
12	58.82
13	24.44
14	24.80
15	39.56
16	23.08
17	35.04
18	32.42
19	18.10
20	42.92
21	18.14
22	22.82
Mean of 22 samples	29.81
Composite of 22 samples	29.88

TABLE 2.—Nitrates in Soil Between Rows and Adjacent to Corn Hills

Nitrate nitrogen, pounds per acre dry soil

Plot	August 10, 1928		August 24, 1928	
	Row	Hill	Row	Hill
9	23	9	30	14
10	39	18	46	12
11	20	9	28	9
15	29	19	39	22
18	26	16	35	11
19	34	16	52	16
21	23	18	58	18

INFLUENCE OF GROWTH OR STAND OF CORN ON NITRATE ACCUMULATION

During the season of 1930 the stand of corn on Section C of the crop-residue plots was decidedly uneven. To obtain information regarding the relation between the nitrate level in the soil and the growth of corn, nitrates were determined in soil from different locations on August 1, 14, and 29. The nitrate content of soil in close proximity to hills of corn classed as good or poor according to the growth and the accumulation in soil midway between the rows are stated in Table 3. It is evident that the nitrate content of soil adjacent to the good stand of corn was less than the amount present between the rows or in soil adjacent to hills of poor corn. The uniformly higher content in soil adjacent to the hills of poor corn does not indicate that deficiency of available nitrogen was responsible for the poor growth of corn on these plots.

SEASONAL VARIATIONS

The amounts of nitrates in soil of several crop-residue plots in corn during 1928, 1929, and 1930 are stated in Tables 4, 5, and 6. The crop rotation on these plots is corn, soybeans for hay, wheat, and clover, so that corn was on a different section each year. During 1928 the average nitrate content of individual plots for all sampling dates from June 1 to November 4, inclusive, was at approximately the same level. The average for all plots on the same date indicates that on August 24 there was a maximum accumulation which decreased in the soil of some of the plots after September 20. On November 4 the nitrate level was appreciably lower than during the period from June 1 to August 24.

In 1929 the nitrates found in soil at intervals during a shorter period extending from July 2 to October 26 did not vary to any considerable extent from the amounts present in the soil the year previous. The nitrate content on October 26 had decreased appreciably from the level in soils at previous sampling dates.

During the season of 1930 nitrates in crop-residue plots of Section C in corn were determined during the period from May 15 to November 13, inclusive. The year 1930 was especially abnormal with respect to rainfall. Although there was less removal of nitrogen by the much smaller corn crop grown in 1930, as compared with the crop of 1929, due to deficiency of rainfall, there was no great increase in nitrate accumulation over that in the soil during 1929. The effect of the decreased removal of nitrogen by the poor corn crop of 1930, however, is reflected to some extent by an increased nitrate accumulation at the end of the season, as compared with the previous years.

TABLE 3.—Nitrate Nitrogen in Soil Between Rows and from Hills With Good and Poor Stands of Corn

Crop-residue plots, Sec. C, 1930. Pounds per acre dry soil

Plot	Treatment (Date ☛)	August 1			August 14			August 29			Average		
		Row	Hill		Row	Hill		Row	Hill		Row	Hill	
			Good	Poor		Good	Poor		Good	Poor		Good	Poor
9	Straw and stover spread on sod in fall	54	28	50	32	26	42	20	12	40	35	22	44
10	None	40	30	38	52	30	40	38	26	32	44	30	37
11	Straw and stover spread on sod in spring	44	40	38	46	30	42	32	26	32	40	32	38
15	Straw and stover spread on sod, and sulfate of ammonia and limestone equal to that used in artificial manure on Plot 18 applied	54	36	60	54	46	100	40	36	92	47	39	84
18	Straw and stover made into artificial manure by sulfate of ammonia and limestone process and applied to sod	48	32	72	50	26	48	46	22	40	48	26	53
19	None	38	20	38	46	26	52	44	18	40	42	21	43
21	Crops fed, and ½ the manure produced applied to corn	60	28	80	60	54	100	46	40	88	55	40	89
Average untreated plots		39	29	38	49	28	46	41	22	36	......	......	......
Average treated plots		52	33	60	48	36	66	37	27	58	......	......	......

TABLE 4.—Nitrate Nitrogen in Soil of Crop-residue Plots in Corn, Sec. D, 1928

Pounds per acre dry soil

Plot	Treatment / Date	June 1	June 16	July 6	July 10	July 23	Aug. 10	Aug. 24	Sept. 20	Oct. 4	Oct. 14	Nov. 4	Average
9	Straw and stover spread on sod in fall	22	38	25	46	19	23	30	16	8	16	10	23
10	None	20	42	25	27	19	39	46	44	12	40	12	30
11	Straw and stover spread on sod in spring	26	28	36	23	33	20	28	12	12	16	12	22
15	Straw and stover spread on sod, and sulfate of ammonia and limestone equal to that used in artificial manure on Plot 18 applied	29	34	40	40	44	29	39	80	16	32	20	37
18	Straw and stover made into artificial manure by sulfate of ammonia and limestone process and applied to sod	30	42	28	22	30	26	35	46	12	16	14	27
19	None	37	34	26	28	34	34	52	16	22	36	14	30
21	Crops fed, and ½ the manure produced applied to corn	23	48	30	32	32	23	58	36	16	20	12	30
Average untreated plots		28	38	25	27	26	36	49	30	17	38	13	....
Average treated plots		26	38	31	30	31	24	38	38	13	20	14	....

TABLE 5.—Nitrate Nitrogen in Soil of Crop-residue Plots, Sec. A, 1929

Pounds per acre dry soil

Plot	Treatment Date☞	July 2	July 19	Aug. 2	Aug. 21	Sept. 11	Sept. 27	Oct. 10	Oct. 26	Average
9	Straw and stover spread on sod in fall.	27	31	26	21	18	13	8	4	19
10	None.	43	45	33	21	50	44	28	16	35
11	Straw and stover spread on sod in spring.	38	40	32	24	30	27	18	13	28
15	Straw and stover spread on sod, and sulfate of ammonia and limestone equal to that used in artificial manure on Plot 18 applied.	32	36	28	22	60	50	43	11	35
18	Straw and stover made into artificial manure by sulfate of ammonia and limestone process and applied to sod.	52	56	43	30	49	40	36	4	39
19	None.	56	54	40	22	31	46	31	7	36
21	Crops fed, and ½ the manure produced applied to corn.	40	43	28	14	41	28	19	4	27
Average untreated plots		49	50	36	22	40	45	29	11	....
Average treated plots		38	41	31	22	40	32	25	8	....

TABLE 6.—Nitrate Nitrogen in Soil of Crop-residue Plots, Sec. C, 1930

Pounds per acre dry soil

Plot	Treatment Date	May 15	May 28	June 15	July 5	July 15	Aug. 1	Aug. 14	Aug. 29	Sept. 15	Sept. 26	Oct. 6	Oct. 24	Nov. 13	Average
9	Straw and stover spread on sod in fall	34	42	44	46	64	54	32	20	26	22	12	18	22	34
10	None	26	40	30	32	60	40	52	38	28	26	16	22	26	34
11	Straw and stover spread on sod in spring	38	46	34	36	62	44	46	32	26	30	26	32	28	37
15	Straw and stover spread on sod, and sulfate of ammonia and limestone equal to that used in artificial manure on Plot 18 applied	42	50	44	44	54	54	46	36	32	24	22	26	24	38
18	Straw and stover made into artificial manure by sulfate of ammonia and limestone process and applied to sod	42	50	40	42	50	48	50	46	36	26	26	30	20	39
19	None	36	38	28	30	20	38	46	44	38	36	32	26	22	33
21	Crops fed, and ½ the manure produced applied to corn	40	44	40	46	46	60	54	40	32	32	24	22	22	39
Average untreated plots		31	39	29	31	40	39	49	41	33	31	24	21	24	....
Average treated plots		39	46	40	43	55	52	46	35	30	27	22	25	24	....

The nitrate content in soil from these same plots on April 14, 1931, before the ground was plowed, was practically at the same level as at the last sampling in November of the year previous. At a later date, June 11, after the ground had been prepared for the 1931 crop of soybeans, there was a decided increase in nitrates. The soybean crop removed considerable quantities of nitrogen, with the result that on July 27 the greater part of the large accumulation of nitrates present in June had disappeared. The data showing the nitrate content on the several dates referred to are in Table 7.

The nitrate content of soil from Section B of the crop-residue plots, that had been in clover in 1930, was determined April 21, 1931, previous to plowing under the residues or manure applied for corn and at later dates during May, June, and July. On April 21 the nitrate content was approximately the same as was found after August 29, 1930 in soil of crop-residue plots of Section C in corn during 1930. In May and June there was a considerably increased nitrate content as shown in Table 8. An increase in ammonia nitrogen accompanied the increased nitrate nitrogen present at the later dates. At the end of July the nitrate supply was rapidly disappearing and was less than was present in April.

It has been found that the drying of soil with subsequent re-wetting produces changes in its biological, chemical, and physical condition that increase nitrification. This dehydration effect during the drouth period of 1930 undoubtedly has contributed to the abnormally large accumulation of nitrates that occurred in the following year of 1931.

TABLE 7.—Showing Nitrate Content of Soil, Crop-residue Plot, Sec. C, on November 13, Season of 1930, and in Soil of Same Plots in Soybeans Sampled on April 14, June 11, and July 27, 1931

Pounds per acre dry soil

Plot	Date sampled ☞ Treatment	Nov. 13, 1930	April 14, 1931	June 11, 1931	July 27, 1931
9	Straw and stover on sod in fall.	22	26	350	11
10	None.	26	25	290	9
11	Straw and stover spread in spring.	28	16	144	9
15	Straw and stover spread on sod, and sulfate of ammonia and limestone equal to that used in artificial manure on Plot 18 applied.	24	22	250	12
18	Straw and stover made into artificial manure with sulfate of ammonia and limestone.	20	20	288	9
19	None.	22	23	90	5
21	Crops fed, and one-half the manure produced applied to corn.	22	22	140	11

TABLE 8.—Nitrate and Ammonia Nitrogen of Soil, Crop-residue Plots, Sec. B, in Corn 1931

Pounds per acre dry soil

Plot	Treatment / Date sampled	April 21, 1931		May 27, 1931		June 11, 1931		July 27, 1931	
		Nitrate nitrogen	Ammonia nitrogen	Nitrate nitrogen	Ammonia nitrogen	Nitrate nitrogen	Ammonia nitrogen	Nitrate nitrogen	Ammonia nitrogen
9	Straw and stover on sod in fall	32	8	54	18	156	18	13	2
10	None	26	6	94	22	116	30	11	2
11	Straw and stover spread in spring	26	6	170	18	112	22	7	4
15	Straw and stover spread on sod, and sulfate of ammonia and limestone equal to that used in artificial manure on Plot 18 applied	36	6	158	22	264	22	7	1
18	Straw and stover made into artificial manure on Plot 18	34	12	126	16	94	30	7	0
19	None	22	0	120	18	70	22	7	2
21	Crops fed, and ½ the manure produced applied to corn	38	4	126	20	112	26	12	1

TABLE 9.—Nitrate Nitrogen in Soil of Legume-reaction Plots, Sec. B, March 1931

Pounds per acre dry soil

Plot	Hay crop*	Soil depth	March 1931								July 20
			pH 5		pH 6		pH 7		pH 8		pH 8
			North	South	North	South	North	South	North	South	South
		In.									
†	Red clover	0-7	40	36	44	39	48	39	32	45	24
		7-14	48	55	58	56	76	57	74	63	2
2	Mammoth clover	0-7	36	35	39	39	31	80	53	48	28
		7-14	53	60	62	60	94	92	60	78	6
3	Alsike clover	0-7	53	42	45	41	40	48	45	54	20
		7-14	55	59	46	56	55	74	57	81	10
5	Sweet clover	0-7	39	31	36	34	35	50	64	58	18
		7-14	40	40	50	47	51	70	64	59	8
6	Alfalfa	0-7	34	32	46	32	40	43	74	59	20
		7-14	52	36	52	43	80	95	86	71	12
8	Soybeans	0-7	26	22	32	26	34	36	45	39	18
		7-14	32	36	28	26	46	50	42	34	8
9	Timothy	0-7	28	28	32	35	53	44	40	44	16
		7-14	36	35	28	25	57	56	48	48	4
Average of clover plots including alfalfa		0-7	40	35	42	37	39	52	54	53	....
		7-14	50	50	54	54	71	77	68	70	....
Soybeans		0-7	26	22	32	26	34	36	45	39	....
		7-14	32	36	28	26	46	50	42	34	....
Timothy		0-7	28	28	32	32	53	44	40	44	....
		7-14	36	35	28	25	57	56	48	48	....

*Hay crop on plots 1929 previous to corn crop of 1930. Crop rotation has been corn, oats, hay.

†Average check plots 1, 4, 7, 10. The south ends of the plots receive applications of superphosphate, 250 pounds on corn and 500 pounds on smal

EFFECT OF TREATMENT

The crop-residue plots have received additions of organic materials supplied by straw, stover, and manures, as stated in Tables 4 to 6, inclusive, in which the nitrate data are given. Although various treatments may either favorably or adversely influence production and accumulation of nitrate nitrogen in soils, the nitrate content of the differently treated plots has furnished no positive indications of the effect of treatment.

In 1929 the average nitrate content for individual plots for the whole period during which nitrates were determined was lower in Plots 9 and 11 when straw and stover were spread on sod in the fall and spring, and also in Plot 21 treated with manure from crops fed. The averages for untreated and treated plots at each sampling date show a slightly higher content in the soil that had no addition of organic residues.

During the season of 1930, there was a small increase in the treated over the untreated plots from May 15 to August 1. From this date to the end of the period during which nitrates were determined, this difference disappeared and the amounts of nitrates in the soil of treated and untreated plots were approximately the same. After August 29 there was a decreased accumulation in both the treated and untreated soil. Seasonal weather conditions and removal by crops have apparently had a greater effect on the nitrate content of these soils than did the treatments.

RELATION TO SOIL REACTION

Although nitrate production in moderately acid soils may be adequate for the requirement of crops, providing other factors are satisfactory, there is evidence that nitrification may be stimulated where the reaction of the soil is changed by addition of liming materials.

Variations in the nitrate content of soils from the soil-reaction series of plots maintained at different pH values furnish some indications of the effect of soil reaction. The nitrate content of these soils that were in corn the previous year is stated in Table 9.

It will be noted that with the reaction of the surface soil above 6 pH the nitrate content tended to increase in both the surface and subsoil. The relatively larger accumulation of nitrate nitrogen in these soils in March 1931, as compared with that in soils of the crop-residue plots also in corn during 1930, is considered to be due to the fact that corn yields on the reaction plots were decidedly lower than on the crop-residue soils. The 1930 corn yields on these two series of plots are stated below:

CROP-RESIDUE PLOTS

Plot	Bu.
9	20.67
10	22.17
11	27.73
15	30.45
18	23.99
19	20.34
21	24.16

LEGUME-REACTION PLOTS, pH 7

Plot	Bu.
*	8.10
2	14.54
3	12.00
5	16.11
6	16.33
8	9.49
9	11.80

*Average check plots.

RELATION TO PREVIOUS HAY CROP

The hay crops preceding corn in the rotation of crops grown at the different soil reactions are as stated in Table 9. The effect of soybeans, as compared with clover and alfalfa, on the nitrate content of the soil is shown by the smaller accumulation of nitrates in the soil on which the previous hay crop was soybeans.

A significant variation in the nitrate content of the several plots on which these crops were grown is the larger amount of nitrates in the subsoil of the clover and alfalfa plots, as compared with that of the soybean and timothy plots. On July 20, after the 1931 oat crop on these legume-reaction plots was harvested, the nitrate content was reduced considerably, especially in the subsoil.

SOURCES OF MILK AND CREAM MARKETED IN NORTHEASTERN OHIO

C. G. McBRIDE AND T. K. COWDEN

A survey of the sources of milk and cream consumed or manufactured in northern Ohio in 1930 reveals a total of 90,524 farms selling milk or cream in these markets. Of this total 23,004 farms are under the Board of Health inspection of one or more of the following cities: Cleveland, Akron, Canton, Toledo, Pittsburgh, Dayton, and Springfield. Fluid milk is being sold to manufacturing plants not under the Board of Health inspection of any Ohio city by 10,386 farms. The remaining 57,134 farms sell sour cream.

Geauga County, with 71 per cent of its total farms under city inspection, is the most intensive dairy county in the State. It also ranks highest of all counties in value of dairy products per square mile and number of cows per 100 acres of crop and pasture land. Medina and Portage Counties are next in rank, each with 57 per cent of their farms under city milk inspection.

The counties of northern Ohio were classified with reference to their major dairy activities. In the following counties production of milk for sale to city dealers predominates: Ashland, Ashtabula, Belmont, Champaign, Clark, Columbiana, Cuyahoga, Geauga, Greene, Lake, Lorain, Lucas, Medina, Miami, Montgomery, Portage, Sandusky, Stark, Summit, Trumbull, Tuscarawas, Wayne, and Wood. In the three counties Fulton, Holmes, and Ottawa, fluid milk sales to cities and to manufacturing plants are of approximately the same importance.

Fluid milk sales to manufacturing plants predominate in Defiance, Henry, Union, Van Wert, and Williams Counties. Milk for manufacturing and sour cream are of about equal importance in the following counties: Allen, Auglaize, Hancock, Hardin, Mercer, Paulding, and Putnam; whereas the sale of sour cream predominates in Carroll, Coshocton, Crawford, Darke, Guernsey, Harrison, Knox, Marion, Morrow, Preble, Richland, Seneca, Shelby, and Wyandot Counties.

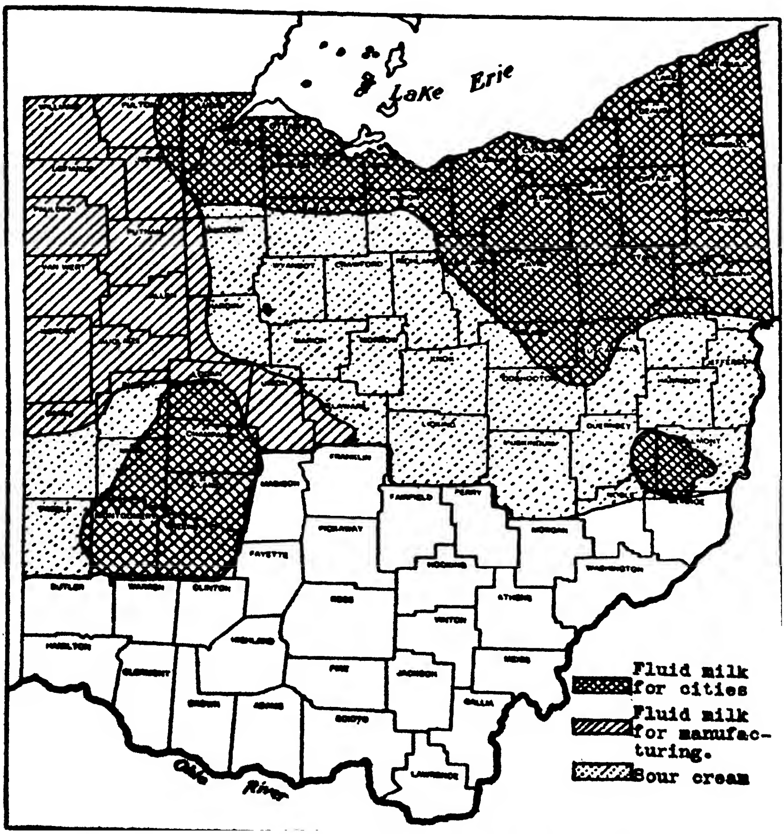


Fig. 1.—Division of northern Ohio according to the major outlet for dairy products to northern Ohio markets

INDEX NUMBERS OF PRODUCTION, PRICES, AND INCOME

J. I. FALCONER

A declining price level has been a characteristic of the past 2 years. Wholesale commodity prices are now back to the pre-war level; retail prices are still somewhat higher. In July the prices paid by farmers for commodities purchased were 28 per cent above the pre-war level, a decline from 48 per cent above in July 1930. Wages are being reduced. In August of 1931, Ohio farm products were selling at prices 13 per cent below the 1910-1914 average.

Trend of Ohio Prices and Wages, 1910-1914=100

	Wholesale prices, all commodities U. S.	Weekly earnings N. Y. State factory workers	Prices paid by farmers for commodities bought U. S.	Farm product prices U. S.	Ohio farm wages	Ohio farm real estate	Ohio farm product prices	Ohio cash income from sales
1913........	102	....	100	100	104	100	105	100
1914........	199	100	101	102	102	102	105	107
1915........	102	101	106	100	103	107	106	110
1916........	125	114	123	117	113	113	121	121
1917........	172	129	150	176	140	119	182	198
1918........	192	160	178	200	175	131	203	243
1919........	202	185	205	209	204	135	218	266
1920........	225	222	206	205	236	159	212	242
1921........	142	203	156	116	164	134	132	136
1922........	141	197	152	125	145	124	127	136
1923........	147	214	153	135	166	122	134	149
1924........	143	218	154	134	165	118	133	150
1925........	151	223	159	146	165	110	159	164
1926........	146	229	156	136	170	105	155	176
1927........	139	231	154	131	173	99	147	163
1928........	143	232	156	139	169	96	154	147
1929........	141	236	155	138	169	94	151	161
1930........	126	226	146	117	154	90	129	130
1930								
January...	136	234	153	134	158	....	141	159
February..	135	231	152	131	....	....	137	114
March.....	133	235	151	126	....	90	132	131
April.....	132	231	151	127	158	....	136	135
May.......	130	228	150	124	....	....	132	128
June.......	127	227	149	123	....	....	131	138
July.......	123	224	148	111	155	....	123	134
August....	123	224	147	108	....	....	125	116
September.	123	227	146	111	....	....	129	126
October....	121	220	144	106	147	....	125	133
November.	117	215	142	103	....	....	122	124
December..	114	216	139	97	....	....	112	119
1931								
January...	112	212	137	94	133	....	106	115
February..	110	215	136	90	....	....	98	85
March.....	109	219	134	91	....	82	100	104
April......	107	215	133	91	119	....	103	97
May.......	104	211	130	86	....	....	98	90
June.......	102	207	129	80	....	....	93	93
July.......	102	207	128	79	115	....	86	86
August....	....	....	....	75	....	....	87	90

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